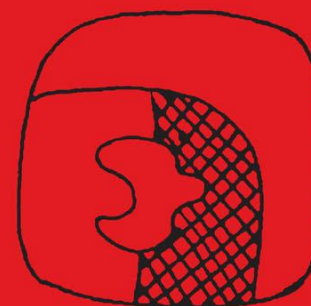


Food, Fire and Fragrance:  
A Paleoethnobotanical  
Perspective on Classic Maya  
Cave Rituals

Christopher T. Morehart



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A PALEOETHNOBOTANICAL PERSPECTIVE ON CLASSIC MAYA CAVE RITUALS**

**Christopher T. Morehart**



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## PREFACE

I first wrote this monograph as a master's thesis for the Department of Anthropology at Florida State University in 2002. I collected the data during my participation on the Western Belize Regional Cave Project, directed by Jaime Awe. Since I wrote the thesis, there has not been another study (at least not published) on Maya cave rituals focusing on archaeobotanical data. Indeed, with few exceptions (e.g., McNeil 2009), virtually no other paleoethnobotanist has studied how the ancient Maya interacted with their spiritual universe via ritual practice.

As I review in this work, archaeobotanical studies are still rare in the Maya region, though this has been changing. In terms of caves, I find this situation as perplexing as when I first began as a paleoethnobotanist. There are few kinds of archaeological contexts in this region that permit good preservation. Of course, these caves are not the arid caves of Peru, of the Southwest United States, or even of Puebla, Mexico. They are hot and humid—conditions that seem terrible for the long term preservation of organic remains. But, in general, they differ remarkably from the environment outside. Outside these caves one finds inter- and intra-seasonal fluctuations in temperature and precipitation. Inside, however, caves are stable micro-environments. This stability offers archaeologists a rare opportunity to access a component of past life that was so central but, today, is so utterly absent from our records.

I decided to publish this thesis because it still has intrinsic value for anthropological archaeology generally and for Maya archaeology specifically. When I conducted this research, I recall feeling lucky. To my mind, the archaeological landscape is littered with stones, bones, and pottery. How many ears of maize have Maya archaeologists found? How many bean cotyledons or squash rinds? How many fragments of cloth? I recovered more archaeobotanical remains (in terms of diversity and overall abundance) than what is commonly recovered from an *entire* habitation site from a *single* feature at Barton Creek Cave. Although they may never have enough exotic romance to appear on the cover of National Geographic, these items are rarer than jade.

To my knowledge, this monograph will be the only one of its kind—the only full length book on paleoethnobotany in Maya archaeology. In general, little has changed in the field itself in the past eight years. Though archaeobotanists continue to make methodological advances (especially in micro-floral research), it is still an under-utilized discipline in the Maya area (I still am amazed that many archaeologists seem bewildered by flotation!).

On the other hand, many more publications have appeared on the ancient Maya use of caves. However, I have decided to publish the thesis with little alteration. I do not think that this body of literature fundamentally changes anything in this work. Archaeologists continue to study the ritual use of caves in ways that differ little from

how I treat them here, at least conceptually. Moreover, I did not want to change the way I originally interpreted these data, even though I have since expanded on my initial views in several publications. I do, however, want to recognize key publications that have been produced since 2002, which directly deal with the cave sites included in this monograph. For sake of space and time, however, I omit theses, dissertations, and conference papers.

Since 2002, I have employed different components of these data to understand various dimensions of ritual practice (Morehart 2005; Morehart et al. 2004; Morehart and Butler 2010; Morehart et al. 2005). These papers have ranged from the ritual use of particular kinds of woods to the offering of foods. Awe et al. (2005) presented a comparative perspective on the erection of monuments in caves in the Belize Valley, including Chechem Ha cave. Moyes (2005a, 2005b; Moyes et al. 2009) has presented comprehensive studies of the archaeology of Chechem Ha cave. This work offers a level of detail rarely employed in cave archaeology and also takes seriously the importance of plant remains (i.e., charcoal) in understanding past human behavior. Halperin (2005) published a paper on Actun Nak Beh that looks at the role of pilgrimages, social cooperation, and competition in ritual practices. Halperin et al. (2003) examined the ritual use of *jute* shells in several of the caves discussed here. Owen (2005) presented a systematic analysis of human remains from Barton Creek Cave. Griffith and Jack (2005) studied cave rock art, specifically examining Actun Halal. Moreover, Lohse (Lohse et al. 2008) revisited Actun Halal in order to examine the rock shelter's Archaic period component.

I am sure that this list is far from exhaustive, and the Western Belize Regional Cave Project continues to produce important reports on the use of caves in the Belize Valley, including some of the caves included in this study. About five years ago, two volumes on the use of caves in Mesoamerica appeared, which have become foundational texts for this research (Brady and Prufer 2005; Prufer and Brady 2005). Moreover, many more publications on ritual cave use now exist that are not included in this work. These publications are significant and, sometimes, quite brilliant in terms of method and interpretation. Yet, as I mentioned above, I do not feel that they have fundamentally altered the ways archaeologists, anthropologists, and historians view caves in Mesoamerica since I originally wrote this work.

To reiterate, I feel that the data presented in this monograph have intrinsic value that should not be overlooked or buried in a relatively hard to obtain thesis. The goal of this monograph is to make this information more accessible to scholars. Although I have successfully published aspects of the data in various sources, I present them here in a less mediated and relatively unaltered form from their original appearance. I assume responsibility for any omissions, errors, or intellectual naïveté.

## CHAPTER 1

### INTRODUCTION

Paleoethnobotany, or the study of ancient humans' interaction with the plant world, has had a relatively short history in Maya archaeology. The majority of ancient Maya paleoethnobotanical studies have focused on obtaining an understanding of prehistoric Maya economic and environmental conditions. With few exceptions, there have been no systematic efforts to understand ancient Maya ritual utilizing botanical data. The present work is an investigation of the symbolism and ritual significance of plants in ancient Maya society utilizing archaeobotanical remains recovered from ceremonial archaeological contexts.

Maya cave archaeology provides a unique opportunity to understand the role of plants in prehistoric Maya ritual experience. Within the last two decades there has been a growing appreciation of the role of caves in Maya cosmology. By using archaeological data in conjunction with ethnography, ethnohistory, iconography, and epigraphy, prehistorians have learned that the ancient Maya perceived caves as sacred areas of the natural landscape (Awe, ed. 1998; Bassie-Sweet 1991, 1996; Brady 1989; Pohl and Pohl 1983; Stone 1995; see Chapter 3). Caves were believed to have provided access to the underworld. Thus, caves were the stage for ceremonial activities that were heavily laden with cosmological import.

Above all, the present study is an exploration of the symbolic nature of ritual plant utilization. Analogies drawn from ethnography, ethnohistory, epigraphy, and iconography provide a rich source of data with which to interpret the symbolic nature of archaeobotanical remains from ceremonial contexts. Comparative information reveals that Maya mythological and cosmological concerns extended to plants (Alcorn 1984; Breedlove and Laughlin 1993, 2000; Flores and Balam 1997; Barerra Marin et al. 1976:302-320; McGee 1991; Redfield and Villa Rojas 1934; Vogt 1976). Plants used in rituals were selected based on their symbolic attributes. This feature of Maya ritual experience calls for a perspective focuses on the symbolism surrounding plant utilization in order to reconstruct the meaning of archaeobotanical remains recovered from ancient ceremonial contexts.

These data on plants are incorporated into the broader context of Maya cave archaeology. The archaeobotanical assemblage is the product of archaeological excavations and reconnaissance conducted in seven caves located in the Upper Belize Valley by the Western Belize Regional Cave Project, directed by Dr. Jaime Awe of the University of New Hampshire. The characteristics of the botanical collection contribute to understanding regional patterns in the utilization of caves in the area based on differences and similarities between the cave sites studied. Variations may indicate that distinct social groups were using the caves, or that different types of caves were used

for different ritual purposes (see Chapter 6). Despite regional variations in the botanical collection, there are a number of commonalities, which are interpreted as shared cosmological understandings of ritual behavior that crosscut social, economic, and political differences.

In Chapter 2, the field of paleoethnobotany is defined, and basic definitions and methodologies of paleoethnobotanical inquiry are outlined. This chapter also examines how paleoethnobotanical studies have been implemented in the Maya region. Chapter 2 establishes an interpretative framework for viewing archaeobotanical data recovered from ceremonial archaeological contexts. Iconographic and archaeobotanical data are combined with ethnographic sources in order to examine current knowledge on ancient Maya ritual plant utilization. Ancient Maya botanical offerings can commonly be identified as "food," both real and symbolic, for the gods (Boremanse 1993:335; Houston and Taube 2000:267; McGee 1990:44; Redfield and Villa Rojas 1934:128; Taube 2002:6). Furthermore, economically and politically dominant groups often appropriated many plants and foods as symbols of their authoritative status (Coyston et al. 1999; Coe and Coe 1996; McAnany 1995:75; Taube 1996).

The role of caves in ancient Maya society must be examined in order to study caves as a source of ceremonially deposited plant materials. Chapter 3 provides a historical sketch of Maya cave archaeology. Using archaeological data in combination with comparative information from ethnography, ethnohistory, iconography, and epigraphy, this chapter addresses some of the dominant symbolic themes surrounding prehistoric Maya cave utilization. Caves provided access to the underworld and were inhabited by deities associated with the forces of the earth (i.e., Awe 1998a; Bassie-Sweet 1991, 1996; Brady 1989; Pohl and Pohl 1983; Stone 1995). Caves represented liminal realms, thresholds, between structurally opposite cosmological spheres: earth and underworld, life and death, and night and day. As such, caves were the loci for ceremonial activities, and archaeological deposits in caves provide a source of data on prehistoric Maya ritual.

Chapter 4 discusses the environmental and cultural characteristics of the Upper Belize Valley. Seven caves from three sub-regions, the Macal River Valley, the Barton Creek Valley, and the Roaring Creek Valley, were the subject of paleoethnobotanical investigations. The environmental and cultural features of these regions are examined, and individual cave sites are described. The Upper Belize Valley was center of substantial occupation from the Middle Formative period to the Late Classic period (ca. 900 B.C.-A.D. 900). By the Late Classic period (ca. A.D. 600-900), the Upper Belize Valley probably suffered from environmental stress affecting the entire southern Maya Lowlands (Abrams and Rue 1988; Abrams et al. 1996; Coyston et al. 1999; Curtis et al. 1996; Hodell et al. 1995; Paine and Freter 1996; Rice 1978; White et al. 1993; Wiseman 1978), and inhabitants

were engaged in Late Classic period competitive political struggles (Ashmore and Levanthal 2000; Ball and Taschek 1991:162; Martin and Grube 2000; Taschek and Ball 1999:232; LeCount 1999). Cave rituals likely served as a stage for political competition (Halperin 2002; Helmke 1999; Pohl 1983; Pohl and Pohl 1983). Rulers and factions increased ritual activity in caves in order to obtain ideological power, which they translated into economic and political power.

In Chapter 5, the methodology and results of archaeobotanical analyses are presented on intrasite and intersite scales of analysis. The goal of this chapter is to describe the characteristics of the botanical remains and to explore patterns in the data. Wood charcoal was the most abundant archaeobotanical remain recovered from the cave sites measured by both ubiquity and weight. Pine (*Pinus* sp.) charcoal was particularly prevalent; it was the dominant charcoal genus from each cave. The dominance of pine charcoal is similar to archaeobotanical assemblages from other cave sites and from both ceremonial and non-ceremonial contexts at habitation sites in the Maya Lowlands, suggesting that pine was valued for both ritual and economic purposes.

The remains of domesticated cultigens are also noteworthy, especially those of maize (*Zea mays*). Maize remains were recovered from deposits dated to the Early Classic period and to the Late Classic period, demonstrating a long tradition of offering maize in caves. The maize remains increase in size through time, possibly indicating that ancient Maya agriculturalists were attempting to improve yields by selecting larger sized ears for cultivation. The maize from the cave sites is morphologically similar to maize from many other Maya sites and has affinities to the modern maize complex Chapalote-Nal Tel (see Lentz 1999:4). The use of closely related maize types was evidently widespread during ancient Maya society.

This study presents findings on archaeobotanical analyses that have rarely been applied, particularly starch grain analysis and chemical residue analysis. Starch grain analysis of soil and residues from Actun Chechem Ha yielded ancient starch grains that can be identified morphologically as maize. Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry was carried out on carbonized residue samples thought to be possible incense remains from Actun Nak Beh, Actun Chechem Ha, and Barton Creek Cave. Results of the analyses are preliminary but show that the residues are composed of chemical compounds found in pine and in taxa of the Burseraceae plant family, plants that are commonly used to make incense in Mesoamerica today.

Discussions of the archaeobotanical assemblage are presented in Chapter 6. This chapter examines the symbolism surrounding the burning of wood and residues and explores the ceremonial significance of selected genera of wood charcoal. Many of the wood remains, particularly pine, can be interpreted as symbolic “food”

offerings, or something that is believed to be ceremonially consumed by the gods through burning (see Houston and Taube 2000:267; Miller and Schele 1986:176; Taube 2002:10). Similarly, botanical food remains, such as domesticates and tree fruits, were food offerings to the gods and ancestors. Domesticated plants, including maize, beans, squash, and chile peppers, were likely offerings to earth deities believed to control the forces of nature. Such offerings were probably made to compensate the earth gods for the use of their domain before and after agricultural harvests (Boremanse 1993; Redfield and Villa Rojas 1934; Vogt 1976). The tree fruits, nance (*Byrsonima crassifolia*) and cohune palm (*Attalea cohune*), were associated with a secondary burial at the entrance of Actun Nak Beh. This individual may have been an ancestral figure in Cahal Uitz Na’s ruling lineage (Halperin 2002:107-108). The tree fruits are interpreted as evidence that the rulers of Cahal Uitz Na maintained restricted access to orchards of economically useful trees. Their utilization during cave rituals in Actun Nak Beh’s entrance likely symbolized the wealth and power of Cahal Uitz Na’s ruling lineage.

The last section of Chapter 6 places regional differences in the utilization of caves in the Upper Belize Valley in a broader framework of ancient Maya social, political, and ideological dynamics. The intensified use of caves during the Late Classic period is related to broader ecological and political stress affecting the region. Public cave rituals at Actun Nak Beh served to demonstrate Cahal Uitz Na’s dominant group’s access to cosmological power, which was exploited to maintain its political and economic hegemony. Private rituals at cave sites in the rural countryside may have been conducted by rulers attempting to integrate peripheral sacred features with the center, thereby sanctifying the urban city as the center of the cosmos. Alternatively, private rituals at rural cave sites may have served as a ritual arena for non-ruling, subordinate factions in order to acquire ideological power that could be used to maintain political competition with dominant groups.

Despite possible differences in the utilization of caves, the archaeobotanical remains indicate widespread commonalities in the types of plants used for cave rituals. Similar plant remains have been recovered from ceremonial contexts at surface sites, which suggests that the ancient Maya may have maintained a formulaic assemblage of paraphernalia that was used for many different ritual purposes, a characteristic of modern Maya ceremonies (Alcorn 1984:199; Love and Peraza Castillo 1984:282; Redfield and Villa Rojas 1934:128). Furthermore, these similarities reveal a long term and widespread tradition of shared understandings of plant symbolism and of proper ritual behavior. Such shared symbols serve to maintain a collective identity and function to validate and empower all ritual performances.

## CHAPTER 2

### PALEOETHNOBOTANY OF THE MAYA AND THE RITUAL USE OF PLANTS

This chapter presents a brief overview of the field of paleoethnobotany, the study of ancient humans' interaction with the plant world. I will first outline definitions, concepts, and methodologies of paleoethnobotanical inquiry. For more information see Ford (1979), Gremillion (1997), Hastorf and Popper (1988), Pearsall (2000), and Renfrew (1973). Next, I will discuss how paleoethnobotany has been implemented in Maya archaeology, and how such research has helped prehistorians understand the complex relationship between humans and plants in prehistoric Maya society. The last section provides an interpretative framework with which to view ancient plant material recovered from ceremonial contexts, emphasizing symbolism as an essential criterion in the ritual use of plants. Sources on the ceremonial use of plants by the ancient Maya, particularly iconography, epigraphy, and, to a limited extent, archaeobotany, are explored using interpretative data drawn from ethnography and ethnohistory. This process reveals that many plants, though not all, used during rituals were considered symbolic food offerings to the gods. Iconographic data also indicate that plants were often used as symbols for political and ideological power.

#### Terms and Methodologies of Paleoethnobotany

The term paleoethnobotany was first coined by Hans Helbaek (1959), who was working on plant materials from Jarmo, Iraq, at the Danish National Museum in Copenhagen (see also Pearsall 2000:2; Watson 1997:14). Since then many scientists have reiterated and modified Helbaek's definition (Ford 1979:286; Hastorf and Popper 1988:1; Pearsall 2000; Renfrew 1973:1). Overall, there is general agreement that paleoethnobotany focuses on understanding the utilization of plants by ancient people. "Paleo" derives from the Greek word *palaios*, meaning old or ancient. "Ethno" is from the Greek *ethnos*, meaning people. Finally, botany is the branch of biology that studies plants, their structure, classification, evolution, and relationships.

Many scholars believe that paleoethnobotany provides information only on prehistoric interactions with the plant world, such as subsistence techniques, resource extraction, and environmental conditions. Ancient floral remains are often classified as ecofacts, or unmodified biological remains, including plants and animals, whose deposition was the result of human activity (Renfrew and Baun 2000:45; Sutton and Arkush 1996:335). Ecofacts are not usually considered artifacts unless there are clear indications that they were modified (e.g., for tool use).

Classifying plant material as ecofacts limits paleoethnobotany's contribution to archaeology. Plant remains have been used to understand key social

processes in prehistoric societies. Paleoethnobotanists have proposed models to explicate gender relations, ritual practices, cultural values, and political developments. For instance, Gumerman's (1994) examination of maize recovered from Moche burials in Peru, stresses the ritual significance of food offerings in Moche funerary practices. Scarry and Steponaitis (1997) explored the changing relationships between wild and domesticated food plants in the development of social and political complexity at Moundville, Alabama, postulating that the consumption of maize became centrally controlled by politically dominant groups (see also Welch and Scarry 1995). At the Classic period Maya site of Copán, Honduras, Lentz (1991) discovered that there is greater diversity in food remains from elite residences, indicating that higher status groups had access to a wider variety of dietary species than lower status groups. In addition, Hastorf (1991) performed spatial and temporal analyses of botanical remains to show the changing role of food production and consumption in gender relations among the Sausa of the Peruvian Andes. As the larger Inca political state began to dominate the Sausa, women began to produce more maize-based food items, possibly beverages for feasts, that were consumed primarily by socially dominant males. Hastorf's study demonstrates that ancient Peruvian women's labor maintained social and political processes while women became increasingly marginalized and subordinate. Additionally, this thesis uses botanical remains to explore social and political processes by examining regional patterns in ritual activity at several cave sites in western Belize.

The primary source of data for paleoethnobotanical inquiry consists of the identification and analysis of plant or floral remains recovered from archaeological contexts. These can be broadly divided into macroremains and microremains. Because the present study relies more on the former, the succeeding discussion will focus primarily on macrofloral material.

Macrofloral remains are botanical specimens that can be seen with the unaided eye, such as seeds, wood, nuts, maize cobs, etc. Paleoethnobotanists often use generalized terms to classify macrofloral material. For example, macrofloral material is frequently referred to as macroremains or macrofossils. Another definition that is useful for the present study is the paleoethnobotanical definition of charcoal. Although many archaeologists group all charred plant remains collectively as charcoal, charcoal technically refers to the charred remains of a plant's woody structures (Smart and Hoffman 1988:167).

There are a number of methods for recovering macroremains (Pearsall 2000:12-15). One can collect materials *in situ* from archaeological deposits. *In situ* collection can be problematic because archaeobotanical remains are often embedded in a soil matrix and can be difficult to see. Dry screening bulk soil samples can be employed for more systematic collection. There are, however, problems with this approach. The screen's

mesh only recovers botanical material larger than the mesh size, and the force used to push soil through the screen may destroy fragile remains. Water screening is useful because it allows the use of smaller sized mesh screens, increasing the recovery rate among plant remains of variable size classes. Water screening does not, however, prevent the destruction of materials as soil is forced through the screen.

Archaeobotanical studies advanced following the introduction of water-based, flotation techniques (Pearsall 2000:15; Struever 1968; Watson 1997:16). Flotation refers to recovery systems that involve the immersion of soil samples into a basin of water. Botanical remains and other small-scale archaeological remains float on the surface and are skimmed or poured off. Flotation allows the recovery of smaller botanical remains, and it is not as destructive to fragile specimens. Problems with flotation have been observed, however (Wagner 1988). For example, mechanical flotation devices generally have a higher rate of recovery than manual systems. Also, many plant materials do not float, including those from waterlogged soils. Thus, the size of the mesh used to catch heavy fractions must be small enough to prevent the loss of archaeobotanical specimens. Finally, some materials may break or disintegrate when they are immersed in liquids.

Microfloral remains are archaeobotanical materials that cannot be seen with the naked eye and necessitate specialized extraction techniques in order to be recovered and high microscopic magnification to be identified. Types of microfloral materials include pollen, phytoliths, and starch grains. Pollen grains are microscopic reproductive structures that form in the anther, the male portion of the flower. The study of pollen, palynology, has been used for paleoecological reconstruction (Jones 1991; Pearsall 2000; Wiseman 1978) and even to understand ancient ritual assemblages (Rue et al. 1989; McNeil 2000). Palynology has been particularly successful in neotropical regions because pollen grains often preserve much longer than macroremains. Consequently, palynology is sometimes used to reconstruct ancient agricultural economies in lieu of extensive macrofloral evidence (Piperno 1994). Palynological signatures of agricultural practices include the presence of pollen from domesticated cultigens such as maize (*Zea mays*), an increase in pollen from plants of early successional floral communities, a decrease in pollen from arboreal species, and a high proportion of charcoal in pollen profiles indicating extensive burning for agricultural land.

Phytoliths are microscopic, silica bodies that occur in stems, leaves, roots, and the flowers of plants (Pearsall 2000). Many phytoliths are diagnostic to particular species and, as a result, can be used for identification. As with pollen, phytoliths are often preserved under adverse environmental conditions. Phytolith analysis has been used with success to understand ancient agriculture (Kealhofer and Piperno 1994) and can be combined with

palynological data to obtain a firmer understanding of prehistoric plant exploitation strategies (Pearsall 2000:483-491).

Paleoethnobotanists interested in documenting the early utilization of cultigens have begun to apply starch grain analysis to archaeological materials. Starch is a type of ergastic substance found in specialized subcellular structures known as amyloplasts (Mauseth 1988:24-25). Amyloplasts occur in plant structures that are dedicated to the long-term storage of nutrients, such as the endosperm of maize kernels. Each amyloplast may have one to several starch grains. Starch grains are variable among species, and individual taxa have morphologically diagnostic starch grains (Piperno and Holst 1998; Reichert 1913). Like pollen and phytoliths, the preservation of starch grains often exceeds macrofloral remains, especially in tropical regions. Starch grain analysis is also helpful in situations where food plants were processed by prehistoric peoples, resulting in the destruction of macroremains. Starch grain analysis has potential not only because it documents the appearance of certain domesticates in the archaeological record, but because it also provides information about the function of ancient artifacts. Paleoethnobotanists have located starch grains from the use surfaces of prehistoric artifacts (Loy et al. 1992; Piperno and Holst 1998; Piperno et al. 2000; Vaughn and Lentz 2001), and from archaeological sediments (Therin et al. 1999).

Although there are several techniques used to collect ancient floral remains, the most informative approaches are those that employ numerous methods. Combining many methodologies, including supplementing older investigations with newer approaches, provides multiple lines of evidence to reconstruct ancient plant utilization. In the following discussion on the implementation of paleoethnobotany in the Maya region, it will become apparent that prehistorians have combined microfloral and macrofloral research. Although many of these studies have focused on microfloral and macrofloral approaches individually, when evaluated collectively a more comprehensive understanding of Maya plant-use strategies emerges. Lastly, the present thesis combines macrofloral data with the results of starch grain analysis, a technique that has not been used extensively in Maya archaeobotany (see Chapter 5).

### **Paleoethnobotany in the Maya Area**

Paleoethnobotany in the Maya region has received little recognition until recently (Lentz 1999). There are a number of reasons for this deficiency. First, there has been a historical bias toward investigations of large-scale, civic-ceremonial centers in Maya archaeology. With the introduction of settlement archaeology in the Maya area (e.g., Willey et al. 1965) and the growing support for processual approaches, archaeologists began to focus their attention on a broader spectrum of Maya society, such as rural settlement trends, economic practices, and ancient environmental conditions (see also

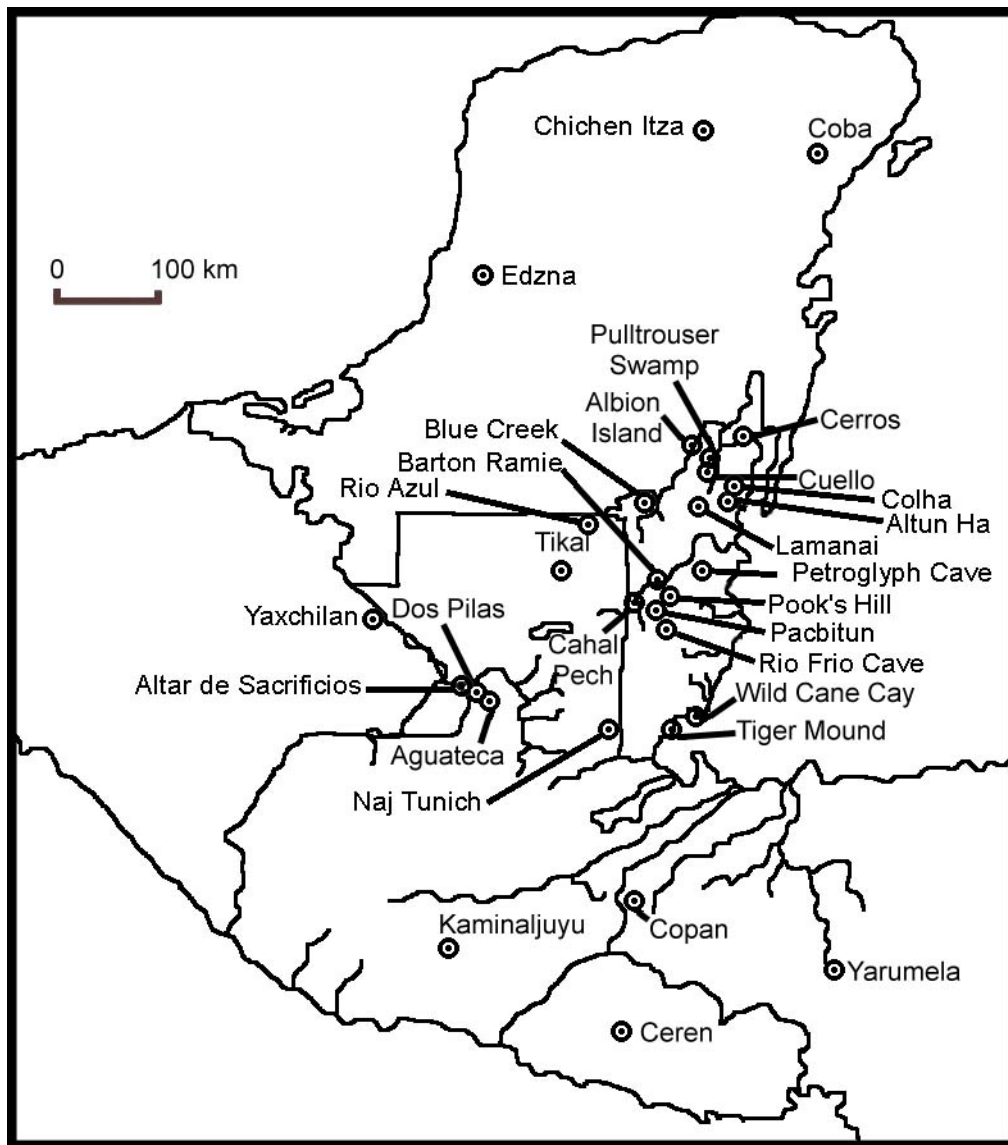


Figure 2.1. Map of Maya region showing Maya archaeological sites discussed in this chapter .

Fedick 1989; Harrison and Turner 1978; Pohl 1990; Webster et al. 2000:9; Willey and Sabloff 1993). Another reason for the lack of archaeobotanical studies in the Maya region is the long held belief that organic preservation is too poor to justify intensive study. Although the tropical environment does take its toll on ancient plant remains, there is intersite and intrasite variation in the long-term preservation of organic material. Consequently, no researcher can predict the success of paleoethnobotanical studies until after recovery and analysis.

As I will discuss below, paleoethnobotanical investigations at Maya archaeological sites have focused predominantly on reconstructing ancient environmental conditions and economic adaptations, including agricultural and subsistence practices, resource extraction techniques, and general utilizations of botanical products. Researchers have applied both macrofloral and microfloral recovery strategies in order to obtain a more thorough understanding of prehistoric Maya ethnobotany. Although substantially more

information needs to be collected, botanical data from the Archaic period to the Postclassic period from many Maya sites are represented in the archaeobotanical record (Figure 2.1), demonstrating that the ancient Maya maintained a long, complex relationship with the plant world.

Archaeobotanical research has shown that the types of botanical resources used throughout Maya prehistory were established in Maya economic systems at an early date. The ancient Maya cultivated numerous species of domesticated crops, had developed a system of arboriculture at least by the Late Formative period, and extracted a number of botanical products from forests for fuel and construction materials. Social differences influenced the access to botanical food products, especially during the Late Classic period, in which higher status groups consumed proportionately greater amounts of domesticated food items, such as maize. Palynological evidence indicates that by the end of the Classic period many regions in the southern Maya Lowlands were heavily deforested due to continued

intensive and expansive agriculture, a factor that was a substantial contributing factor to the social, political, and demographic decline of the Classic Maya “collapse.”

## Agriculture

The ancient Maya cultivated a diverse array of domesticated plants for food and for other purposes such as maize, beans, squash, manioc, chile peppers, and cotton. The types of agricultural practices employed varied temporally due to social, political, demographic, and ecological changes through time and geographically due to regional environmental conditions. Agricultural practices can be separated into two primary forms: outfield and infield. Outfield agriculture focused on planting on tracts of land that were geographically removed from the farmers’ residences. Types of outfield agriculture included slash and burn and slash and mulch in alluvial bottomlands and fertile foothills (Fedick 1994; Fedick 1996; Ford and Fedick 1992), terraced-based agriculture in fertile foothills in order to reduce erosion and increase productivity (Fedick 1996; Turner 1978), and raised or drained fields in wetland areas (Pohl 1990; Pohl et al. 1996; Turner and Harrison 1983). Infield agriculture focused on land that was geographically proximate to the farmers’ residences. Types of infield agriculture included interstitial infields, or planted tracts of land located between residences, and home-gardens. Whether there were substantial differences in the types of domesticated crops grown in outfields and infields is unclear. The existence of interstitial infields may be due to a lack of available outfield land. Thus, differences in the assemblage of domesticated plants grown between the two forms may have been minimal. Home-gardens, however, were likely planted with crops used more for condiments and medicines (Wisemen 1978:80-81).

Palynological research has documented destructive impacts of intensive and expansive agriculture on the environment during the Late Classic to Terminal Classic periods (see Chapter 4). Wisemen (1978:114) observed a dramatic change from maize to weedy successional species and, eventually, to a forest-dominated landscape in the pollen profiles from Petén, Guatemala, indicating a rapid degeneration of the environment that coincided with in the region’s abandonment. According to Abrams and Rue (1988) and Abrams et al. (1996), the palynological data from Copán, Honduras, reflect a polity that relied on an agricultural regime that was continually expanded and intensified in order to meet growing population requirements, contributing to deforestation and demographic decline. In contrast, recent palynological, magnetic, and lithological studies by Johnston et al. (2001) on sediment cores from Laguna Las Pozas in the Río de la Pasión region of Guatemala, yielded evidence of forest clearance and disturbance species between A.D. 900-1200, indicating an Early Postclassic period colonization by agriculturalists when much of the Río de la Pasión region was undergoing abandonment.

## Maize

Maize (*Zea mays*) was the most widely cultivated crop during Maya prehistory. Due to its substantial role in ancient Maya subsistence economies, maize remains are often the most abundant domesticated cultigen recovered through macrofloral and microfloral techniques. Palynological research in the Maya region has revealed that maize agriculture was present by the Late Archaic period (ca. 3400 B.C.) in northern Belize (Pohl et al. 1996:363). Maize cultivation became common in northern Belize after 2400 B.C. and was widespread in the Maya Lowlands by the Middle Formative period (ca. 900-300 B.C.) (Dunning et al. 1998; Islebe et al. 1996; Rue 1987; Tsukada 1966:63; Vaughan et al. 1985; Wisemen 1978).

Macrofloral remains of maize have been recovered from many Formative period sites in the Maya Lowlands such as Copán, Honduras (Lentz 1991), Yarumela, Honduras (Lentz et al. 1997), Urias, Guatemala (Vaughn and Lentz 2001), Santa Leticia, El Salvador (Miksicek 1986), Pacbitun, Belize (Weisen and Lentz 1999), Albion Island, Belize (Miksicek 1990), Cerros, Belize (Cliff and Crane 1989; Crane 1996), and Cuello, Belize (Miksicek 1991; Miksicek et al. 1981). The maize remains from Cuello are among the earliest maize macrofloral remains recovered from the Maya lowlands. Maize remains from Cuello span the time period from the late Early Formative period to the Late Formative period (ca. 1100 B.C. to A.D. 250). Variation in maize morphology through time at Cuello indicates changes and improvements throughout the Formative period, possibly due to hybridization with highland varieties (see Chapter 5). Although little morphological data are available for maize from other Formative period sites, it is likely that early forms of maize cultivated at these sites underwent a similar process of change and improvement through time.

By the Classic period (A.D. 250 [300]-900 [1000]), maize agriculture expanded and intensified in the Maya Lowlands in order to meet the subsistence demands of the growing population and probably to maintain a surplus for the growing social, economic, and political power of rulers and factions. Morphological information on the types of maize grown by the Classic period Maya is not abundant. Nevertheless, most maize discovered from Classic period sites appears to have affinities to the *Chapalote-Nal Tel* maize complex, a lowland, early-maturing maize group that has short ears and eight to twelve rows of kernels (Lentz 1999:4, see Chapter 5). Sites that have yielded maize similar to Chapalote-Nal Tel include Early Classic period (ca. A.D. 585-600) contexts from Cerén, El Salvador (Lentz et al. 1996a:253), and Late Classic period (A.D. 600-900) contexts at Copán, Honduras (Lentz 1991:272), Altar de Sacrificios, Guatemala (Willey 1972:248), Barton Ramie, Belize (Willey et al. 1965:529), and Pook’s Hill, Belize (Morehart 2002a). The latter two sites are in the

Upper Belize Valley, geographically close to the cave sites studied in the present thesis.

The widespread cultivation of Chapalote-Nal Tel maize likely provided significant adaptive benefits for the Classic period Maya. Population rates and political competition in the Maya Lowlands were highest during the Late Classic period, necessitating increased agricultural productivity to maintain subsistence and tribute requirements. The Maya reacted to these stresses by intensifying agriculture, as evidenced by the presence of extensive terrace systems (Fedick 1994; Turner 1978:168-170; Willey et al. 1965:574-575; Wright et al. 1959:112-113) and raised fields (Turner and Harrison 1983) (see Chapter 4). The Maya probably also responded to these conditions by cultivating maize varieties with higher yield potential. The shorter maturation period of Chapalote-Nal Tel maize may have permitted multiple harvests per year, thereby increasing farmers' yearly maize yields.

### Beans

Beans (*Phaseolus* sp.) are another cultigen that has been recovered from the Maya lowlands, which likely played a substantial role in ancient Maya diets. A diet based on maize alone is deficient in certain amino acids that are critical for human nutrition, such as tryptophan (Lentz 1999:5). Beans adequately supplement the amino acid deficiency of maize. Also, beans grow in a symbiotic relationship with nitrogen-fixing cyanobacteria, specifically *Rhizobium* sp. Thus, growing beans can greatly increase the fertility of nitrogen-deficient soils. Beans are not frequently recovered from Maya archaeological sites, however, because they do not preserve well, and the part of the bean that is most often found, the seed cotyledons, normally would have been consumed rather than discarded (Lentz 1999:5).

The chronological appearance of *Phaseolus* in the Maya Lowlands is not certain. The earliest remains of *Phaseolus* were recovered from late Early Formative period to Middle Formative period (ca. 1100-900 B.C.) deposits at Cuello in northern Belize (Miksicek 1991). These remains are smaller than most domesticated species of beans, so they may represent a wild variety instead. Morphologically domesticated common beans (*Phaseolus vulgaris*) do not appear until the Late Formative period at sites such as Cahal Pech (Wiesen and Lentz 1999), located in western Belize, and Cerros (Crane 1996:267) and Albion Island (Miksicek 1990:309), located in northern Belize. The beans from Albion Island may date to the Early Classic period (A.D. 250-600), however. The lack of beans from chronologically earlier contexts might suggest that fully domesticated beans were not cultivated in the Maya Lowlands until at least the Late Formative period. Conversely, the absence of domesticated beans in pre-Late Formative period contexts may also be the result of poor long-term preservation and the under-representation

of archaeobotanical assemblages from earlier time periods.

By the Classic period (A.D. 250-900), the cultivation of domesticated beans was widespread. Early Classic period deposits from Cerén (Lentz et al. 1996a) and Late Classic period contexts at Copán (Lentz 1991), Barton Ramie (Willey et al. 1965:529), and Cobá (Beltrán Frias 1987) have yielded beans. Archaeobotanical evidence indicates that the Classic period Maya cultivated multiple species of *Phaseolus*. The most widespread species was the common bean (*Phaseolus vulgaris*). Research at Cerén, El Salvador, where the rapid inundation of volcanic ash between A.D. 585 and 600 resulted in the remarkable preservation of plant and organic material, uncovered the remains of common beans, sieva beans (*P. lunatus*), and some wild varieties (Lentz et al. 1996a). The seeds were found mixed together in ceramic vessels, suggesting that the Maya may have sown and cooked them collectively (Lentz 1999:5).

### Squash

Squash (*Cucurbita* sp.) was another dominant domesticated plant cultivated by the ancient Maya. Squash is a good source of dietary nutrients, including carbohydrates, vitamins A and B, calcium, and potassium (Lentz 1999:5). Squash can also be planted with maize, where it grows well between the maize stalks (Lentz 1999:6), a practice of modern farmers of the Upper Belize Valley.

The remains of cucurbits have been recovered from many Maya archaeological sites, from the late Early Formative period to the Late Classic period (ca. 1100 B.C.-A.D. 900), demonstrating that the cultivation of domesticated squash, like that of maize, was an early practice by the ancient Maya. Most squash macroremains consist of carbonized rind fragments, a layer of tissue that cannot be easily identified to species. The most common species of squash that has been recovered is *Cucurbita moschata* (Lentz 1999:10). Archaeobotanical remains of another New World squash, *C. pepo*, are not common, though pollen from pepo squash was reported from Edzná, located in Campeche, Mexico (Lentz 1999:10; Turner and Miksicek 1984). *C. pepo* seeds were found at Cerén, but they may be intrusive material (Lentz 1999:10; Lentz et al. 1996a:254). It is likely that future research will increase our understanding of the number of *Cucurbit* species cultivated by the ancient Maya.

### Root crops

Archaeobotanical research has increased our knowledge of the ancient Maya cultivation of root crops, such as manioc (*Manihot esculenta*). Bronson (1966) proposed that the Classic period Maya intensively cultivated root crops, such as manioc and sweet potato (*Ipomoea batatas*). Bronson wrote at a time when the systematic recovery of botanical remains was not often implemented, and the apparent lack of archaeobotanical



evidence made many doubtful of his claim (Turner and Harrison 1978:348; Turner and Miksicek 1984:180).

Since Bronson's work, archaeobotanical research has yielded macrofloral and microfloral remains of manioc, confirming the validity of his hypothesis. Archaeobotanical research has revealed that the cultivation of manioc took place early in the Maya Lowlands, and manioc cultivation was practiced in conjunction with maize agriculture. Manioc pollen was recovered from Cob Swamp and Colha, both in northern Belize, indicating that the cultigen was introduced to the area prior to 3000 B.C., during the Late Archaic period (Pohl et al. 1996:363). A manioc pollen grain was also found at nearby Cobweb Swamp from a stratum dated to 1000 B.C. (Jones 1991:101). Carbonized stems (Miksicek 1991:80) and possible roots (Hather and Hammond 1994) from manioc were discovered in contexts at Cuello that chronologically date to the early Middle Formative period (ca. 900-600) and the early Late Formative period (ca. 300 B.C.), evidencing a lengthy reliance on root crops in the prehistory of northern Belize.

Archaeobotanical remains of root crops from Classic period contexts are not common. Casts of manioc roots were recovered in a house garden at Cerén (Lentz 1999:11; see also Lentz et al. 1996a), and a possible charred *Xanthosoma* root was found in a Terminal Classic period (ca. A.D. 800-1000) deposit at Tikal (Pohl and Miksicek 1985:15). The lack of root crops dating to the Classic period may be due to an overall decrease in manioc cultivation during this time in order to focus more energy on expanding and intensifying maize-based agriculture. On the other hand, the absence of root crops from many Classic period sites is most likely a combined reflection of the few archaeobotanical investigations undertaken in the Maya region, the poor long-term preservation of root crops, and the lack of trained paleoethnobotanists who can identify root crops.

#### *Chile peppers*

Archaeobotanical remains of chile peppers (*Capsicum annum*) are uncommon in the archaeological record of the Maya region. The part of the chile pepper that is most likely to be recovered, the seeds, are small and highly susceptible to decomposition. Also, chile pepper seeds were probably ground into a powder and consumed rather than discarded.

Chile pepper powder is used as a condiment in foods and drinks. They contain abundant vitamins and were likely a significant source of supplemental nutrients in ancient Maya diets (Lentz 1999:11). Chile peppers are often grown in home gardens by the modern Maya of western Belize, a practice that probably extends into Maya prehistory.

As with maize and squash, chile peppers were cultivated early in Maya prehistory. The earliest chile pepper seeds

from the Maya Lowlands were found in Early Phase II deposits, corresponding to the late Early Formative period and early Middle Formative period (ca. 1100-900 B.C.), at Cuello in northern Belize (Miksicek 1991:82). Late Formative period (ca. 300 B.C.-A.D. 300) contexts at Cerros, also in northern Belize, yielded chile pepper seeds as well (Cliff and Crane 1989:312; Crane 1989:268-270). The best-preserved chile pepper remains are from Early Classic period contexts at Cerén, where carbonized rinds, seeds, and calyxes (fruit bases or peduncles) were recovered in abundance (Lentz 1999:10; Lentz et al. 1996a:255). The chile pepper remains from Cerén were found in storage rooms and kitchens, where they were possibly hung in clusters from the structures' rafters.

#### *Cotton*

Cotton (*Gossypium* sp.) was a significant fiber crop for the ancient Maya. The Maya wove cotton fibers into cloth textiles on backstrap looms. The cloth was used for garments, such as huipils, and for more utilitarian purposes, such as bags. Weaving was primarily a female-focused activity, with mothers passing on their skills to their daughters for generations. Today, weaving is tied with collective identity, as a member of a particular Maya community can be identified by the designs on his or her garments (Osborne 1975; Sayer 1988, 1990).

Cotton was an early component of agricultural assemblages in the Maya Lowlands. At Albion Island, located in northwest Belize, *Gossypium* pollen was found in soil horizons underneath strata radiocarbon dated to 3459-2479 calibrated B.P. (Miksicek 1990:304; Wisemen 1990:320). Cotton cultivation was widespread during the Formative period. A single cottonseed was recovered from a Middle Formative period deposit at Cahal Pech (Wiesen and Lentz 1999), located in western Belize, making it the earliest cotton seed found so far from the Maya Lowlands. Cotton seeds were found in Late Formative period contexts at Cerros and Cuello, both in northern Belize (Cliff and Crane 1989:312; Crane 1996:268; Miksicek 1991:Table 4.2). Cotton pollen was also recovered from Late Formative period contexts at Cerros (Crane 1996:268).

Cotton cultivation may have increased during the Classic period. The largest collection of cotton seeds from the Classic period was found at Cerén, El Salvador. Seventy-four seeds were recovered from a metate trough, suggesting that they may have been ground as a source of cooking oil (Lentz 1999:11; Lentz et al. 1996a:255). Despite this possible domestic use, the primary utilization of cotton during the Classic period was for cloth, particularly cloth used in rituals and for elite tribute. Cotton textiles have been recovered from numerous Classic period ceremonial contexts, such as burials, caches, caves, and cenotes (Brady 1995:33; Carlsen 1987; Lothrop 1992; Rue et al. 1989:398).

The utilization of cotton cloth was likely reserved for high status groups during the Late Classic period. Ethnohistoric documents indicate that Maya elites maintained improved lands that were planted with cotton, and the lower class was obligated to pay tribute in cotton cloth to local lords (Tozzer 1941:26, 215). Classic period vessels often depict cotton cloth being offered to rulers, and many works of Classic period iconography, such as the lintels of Yaxchilan, Mexico, display nobles and rulers wearing elaborate, decorated textiles. The acquisition of cotton cloth, through tribute, served to enhance the power and prestige of Maya rulers. By wearing finely made cotton garments decorated with cosmologically salient symbols, Maya nobles were identified as a distinct social and ideological group from the rest of the population—a factor that assisted in maintaining their economic and political dominance.

### Arboriculture

Many researchers have used ecological data and ethnohistoric documents to argue that the Maya had developed some system of arboriculture, the controlled maintenance and cultivation of economically useful trees also called tree-cropping. Puleston (1968, 1982) theorized that the high density and prominent distribution of ramón (*Brosimum alicastrum*) around the site of Tikal, Guatemala, is evidence that it was once a major staple for the Maya during the Classic period. Puleston's proposition was criticized because archaeobotanical remains of ramón are largely unattested (Lentz 1999:13; Turner and Miksicek 1984:181), and because the contemporary distribution of ramón trees can be related to dry soil conditions, such as the rocky outcrops of ancient abandoned buildings (Lambert and Arnason 1982). Despite the opposition to Puleston's approach, his methodology has been applied elsewhere in the Maya lowlands, such as Cobá, Mexico (Folan et al. 1979).

Paleoethnobotanical research supports the hypothesis that the ancient Maya practiced some system of arboriculture (Lentz 1999:12). The remains of edible fruits from many species of economically useful trees are a common element in archaeobotanical assemblages from ancient Maya sites. The largest limitation in using archaeobotanical remains to infer arboriculture is that fruit remains from cultivated trees cannot always be distinguished from their wild counterparts. Thus, it is often difficult to determine whether a particular tree was cultivated or if its fruits were collected in the wild. Nevertheless, paleoethnobotanists can strengthen their interpretations of tree-cropping by evaluating the relative importance of economically useful trees in archaeobotanical assemblages and by combining their inferences with information from secondary sources, such as ecology, ethnohistory, and iconography.

Prehistorians currently do not know when arboriculture was initiated in the Maya region. Archaeobotanical remains from late Early Formative period and Middle Formative period contexts at many sites, such as Cuello,

Yarumela, and Cahal Pech, demonstrate that the early inhabitants of the Maya Lowlands relied on many trees with edible fruits, including nance (*Byrsonima crassifolia*), cashew (*Anacardium occidentale*), hog plum (*Spondias* sp.), and coyol palm (*Acrocomia aculeata*) (Lentz et al. 1997; Miksicek 1991; Wiesen and Lentz 1999). It is difficult to determine if these trees were cultivated at this time, however.

The strongest evidence for early arboriculture comes from Late Formative period contexts at Cerros, located in northern Belize (Cliff and Crane 1989:308-313; Crane 1996:270-271). Maize was the dominant macrofossil recovered throughout the Late Formative period at Cerros. As Cerros became more socio-politically complex, particularly between A.D. 100-50, there was a reduction in maize and a concomitant increase in nance and coyol palm from the site's urban center, as measured by the ubiquity of recovered macrofloral remains (Cliff and Crane 1989:313). Cliff and Crane (1989:317) interpret these data as evidence that the inhabitants of Cerros decreased the production of subsistence crops in favor of an increased reliance on tree fruits that were imported from elsewhere, speculating that there may have been a central marketplace for the exchange of forest products. An alternative, equally plausible hypothesis, which Cliff and Crane (1989:317) dismiss, is that arboricultural practices at the site increased through time. The spatial contexts yielding archaeobotanical assemblages were restricted to the site core, the area that was inhabited by high status groups as the site became more socially stratified. Ethnohistoric texts of the post-Conquest Yucatec Maya (Tozzer 1941:64) have documented that elites maintained orchards of economically useful fruit trees as a source of wealth. Nance and a number of other economically significant orchard species are represented in the iconography of Pakal's sarcophagus at Palenque, Mexico (Robertson 1983:Figures 174-177) (see Figure 6.6). These representations suggest that orchard species were a source of wealth for Classic period Maya rulers and were a symbolic metaphor for social, political, and economic power (McAnany 1995:75). An increase in tree-cropping at Cerros may be evidence of this practice as early as the Late Formative period.

Classic period evidence of arboriculture is widespread. Copán, Honduras and Wild Cane Cay, Belize, have produced notable evidence of tree-cropping during the Classic period. At Copán, the coyol palm (*Acrocomia aculeata*) was the dominant plant food remain in terms of weight, leading Lentz (1990; see also Lentz 1991:273) to conclude that the coyol palm was one of the most prevalent crops in the Copán Valley during the Classic period. Furthermore, because coyol palm does not occur in deposits that pre-date the Early Classic period to Middle Classic period transition, and because its appearance coincides with the erection of the first Copán stela, Lentz (1990:187) argues that the tree was introduced into the region by Maya settlers by about A.D. 400.

Wild Cane Cay, a Late Classic period to Postclassic period site on the Caribbean coast of Belize, has yielded a significant number of tree fruits, such as cohune (*Attalea cohune*), coyol, coconoboy (*Bactris* sp.), nance, hog plum (*Spondias* sp.), avocado, (*Persea americana*) and calabash (*Crescentia cujete*) (McKillop 1994, 1996). The distribution of maize is limited compared to tree crops (McKillop 1994:Table 1), suggesting that the inhabitants of Wild Cane Cay had a greater reliance on tree cropping than on other cultivation practices.

### Fuel and Construction Materials

The Maya procured a variety of botanical resources for fuel and construction materials. Discerning the function of plant remains that may have been used for construction or fuel is often difficult because many are found in secondary contexts, such as construction fill, and consist of fragments of carbonized wood (Lentz 1999:14). In addition, specimens of wood charcoal from economically useful trees, such as fruit trees, may be indirect evidence for their dietary use rather than evidence for construction materials or fuel sources. One notable exception to this situation is the site of Cerén, El Salvador, where volcanic debris remarkably preserved organic material. The remains of *Trachypogon plumosus*, a perennial grass, were recovered in abundance and are likely the remnants of thatch material from the collapsed roofs of houses (Lentz et al. 1996a:256-257; Lentz et al. 1996b). Also, Miksicek (1991:77) suggests that sawgrass (*Caladium* sp.) specimens from Cuello may represent the waste from roofing thatch. Additional species that were likely used in ancient constructions or fuel include fig (*Ficus* sp.), malady (*Aspidosperma* sp.), cedro (*Cedrela* sp.), oak (*Quercus* sp.), ramón, pine (*Pinus* sp.) as well as many others (see Lentz 1999:Table 1).

### Social Differences in Plant Utilization

Access to certain botanical food products varied among social classes at different time periods in Maya prehistory. Restricted access to certain foods served as a symbolic signature of higher social, economic, and political standing. The evidence for arboricultural practices at Cerros just discussed is the earliest archaeobotanical indication in the Maya area of this process, where the remains of nance and coyol palm recovered from elite areas increased as the site became more socially stratified (Cliff and Crane 1989). One must consider, however, that archaeobotanical samples from Cerros are restricted to the site core, the area inhabited by higher status groups. Thus, the botanical remains deposited during periods of stratification represent only a narrow segment of Cerros' population, elites.

By the Late Classic period, there is clear evidence that higher status groups had greater access to certain botanical food products. At Copán, Late Classic period elite households yielded a higher diversity of dietary species, especially domesticates, than non-elite households (Lentz 1991:281), indicating that higher

status groups had access to a wider variety of plant foods. These findings from Copán are supported by stable carbon and nitrogen isotope analyses on human bone collagen from many sites (see Chapter 4). Stable isotope research is useful because it documents actual consumption rather than patterns of discard uncovered by floral and faunal studies (White et al. 2001:372). At sites like Pacbitun, Lamanai, and Altun Ha, Belize (Coyston et al. 1999; White et al. 1993; White et al. 2001), there were dietary differences among social statuses in which elite individuals consumed a higher proportion of maize-based food items or maize-fed animals and animal protein.

### Plants and Ritual

The previous section summarized our current understanding of plant utilization by the ancient Maya, revealing that paleoethnobotany in the Maya region has been primarily concerned with reconstructing ancient economics and environment. This section provides specific information on the ritual uses of plants in ancient Maya society. First, a theoretical perspective that stresses the multi-functional nature of ancient artifacts is discussed in order to demonstrate that the meaning of plant remains is not limited to reconstructions of prehistoric subsistence economies and environmental conditions. Second, ethnographic data is employed in order to develop a perspective that emphasizes symbolism as the most significant criterion of plants used during rituals. Lastly, the symbolic significance of plants in ancient Maya society, represented in Classic Maya art and writing and by archaeobotanical remains recovered from ceremonial contexts, is explored using analogies drawn from ethnographic and ethnohistoric sources. This approach indicates that plants used in rituals were often considered food offerings, both real and symbolic, to the gods. Furthermore, the combined application of iconography, paleoethnobotany, ethnography, and ethnohistory shows that many plants also served as symbols of social and political power.

### Framework

Understanding the function of artifactual assemblages is a primary archaeological goal. A bias in this process is the assumption that artifacts have static histories. Two functional dichotomies that are often applied are utilitarian versus non-utilitarian and elite versus non-elite (Lesure 1999:24), which presume that artifacts must fall neatly into one category or the other. They do not, and such classifications can lead to simplified inferences of past activities (Walker and Lucero 2000:132).

In order to understand the final functions of ancient artifacts, one must explore the social contexts that led to their deposition. Artifacts had fluid trajectories, and artifacts that are traditionally associated with domestic functions are often found in ceremonial contexts, and artifacts that are used as signatures of higher status may be recovered from archaeological contexts associated

with groups of lower status. For example, ethnoarchaeological research conducted by Deal (1988) has shown that, in general, there are no formal and stylistic differences between the kinds of pottery used in modern Maya family altar rites and those used for domestic purposes. Similarly, there is little difference between the ceramic assemblages recovered from caves and those found at habitation sites in the Maya lowlands (Brady 1989; Helmke 1999). Because the functions of artifacts are used to decipher wider socio-cultural and functional contexts, analyses that are based only on ceramic assemblages from caves using the traditional utilitarian versus non-utilitarian framework might conclude that the ancient Maya inhabited caves or that caves primarily served as depositories for domestic refuse, both erroneous propositions (Chapter 3). LeCount (1999) has shown that polychrome vessels from Xunantunich, Belize, commonly associated with elites, are often found in lower status house mounds during the Terminal Classic period. LeCount argues that this pattern of artifact distribution is the result of an increase in politically motivated feasting and gift-giving in order to develop or strengthen patron-client relationships in light of wider political decentralization in the Upper Belize Valley.

Like any artifact type, plants had multiple functions in ancient cultural systems. Thus, a botanical product that is exploited for its economic utility may be equally valued for its use in ceremonial settings. Although botanical materials collected from ritual contexts do provide insight into ancient subsistence practices and resource exploitation, economic and ecological models are not sufficient to place these data into a culturally meaningful explanation. An interpretative framework that emphasizes the symbolic significance of ritual plant utilization adds a new dimension to Maya paleoethnobotany. Ethnographic information on the modern Maya justifies this approach and offers a backdrop from which to base inferences.

### Modern Maya Ritual and Plant Symbolism

The ethnographic record of the modern Maya is one of the most useful sources of information to interpret ancient ritual plant utilization. One must consider, however, the degree of Spanish influence on post-Conquest Maya ceremonial practices. Kubler (1961) has argued that there is a lack of symbolic continuity since the Conquest among indigenous cultures in the Americas. Kubler holds that all symbolic expressions served to reinforce the power of the dominant colonial state, and that only basic economic practices and a small number of “superstitious” rituals survived.

Although native symbolic modes of thought are often manipulated by dominant, political powers, Kubler underestimates the persistence of traditional beliefs among indigenous societies such as the Maya. Maya religion has been described as a system that can incorporate new ideas and concepts without losing its

basic form (Freidel et al. 1993:38; Vogt 1976:191). Structural similarities between indigenous Maya cosmology and Spanish Catholicism have allowed the Maya to maintain a syncretistic religious system that combines aspects of both traditional Maya and Catholic beliefs, preserving many essential features of native Maya cosmology (Fariss 1984; Freidel et al. 1993). Contrary to Kubler, Farriss (1984:294-296) sees the Maya appropriation of the symbols of Christianity as evidence of resistance rather than domination.

Plants are significant components of modern Maya belief systems, and, thus, the plant world provides a vehicle for symbolism. Among the contemporary Maya, there is a central belief that the natural world is alive or animate (Alcorn 1984; McGee 1990; Redfield and Villa Rojas 1934; Vogt 1969, 1976). All animated things are believed to have a spirit or soul, called *ch'ulel*, which is related to the Classic Mayan words for divinity, *k'uh*, and sacred, *k'uhul* (Taube 2002:6). For the Huastec Maya, the growth of plants is a symbol for the life cycle of humans, and their interrelationships are believed to be a metaphor for social life (Alcorn 1984:94). The Huastec Maya hold that plants are “‘*mas t'okat*,’ more sacred and pure, more respected than humans” (Alcorn 1984:93). Plants, and the entire natural and metaphysical world, exist in a state of structural oppositions (Alcorn 1984:96; Vogt 1976:71). Domesticated plants are associated with culture, and undomesticated plants are associated with the wild realm of nature, a realm inhabited by spirits, monsters, and deities.

For the modern Maya, plants used in rituals are selected for the specific symbolic attributes that are associated with them (Alcorn 1984; Flores and Balam 1997; Barrera Marín et al. 1976:302-320; Redfield and Villa Rojas 1934:130; Steinberg 1999; Ventura 1996; Vogt 1976:66-72). Each plant has its place not simply due to its economic utility but, rather, due to its cosmological and mythological history. In highland Chiapas, Mexico, out of the hundreds of plants that the Tzotzil Maya recognize and use, only about twenty are used for rituals (Vogt 1976). According to Vogt (1976:5), these “plants provide a rich canvas for the portrayal of crucial messages in symbolic code.” The Mopan Maya of southern Belize hold that different colors of maize have distinct symbolic attributes, with black and red varieties having the most spiritual significance (Steinberg 1999:132). Because of the symbolism associated with black and red maize, their use is reserved for celebratory consumption. During rites, the Lacandon Maya of Chiapas, Mexico, use the red dye of achiote (*Bixa orellana*), known as *k'uxu* (McGee 1990:47). The dye is associated with human blood, stressing the sacrificial symbolism that pervades Lacandon ritual. Also, the Yucatec Maya select plants based on their perceived relationships to water for use in *ch'a chak* rituals, or rain ceremonies (Flores and Balam 1997:106).

Plants are often selected for rituals based on structural criteria. The use of plants that are in structural opposition

and their placement on shrines or altars defines the boundaries of rituals as enclosed liminal realms, thereby sanctifying the rite. Tzotzil Maya ritual plant selection is often based on whether or not a plant is perceived as “wild” or “domesticated,” emphasizing the structural duality between nature and culture discussed above, and the Tzotzil and Yucatec Maya use many plants due to their humoral, hot versus cold, qualities (Redfield and Villa Rojas 1934:130; Vogt 1976:66-72).

Whether humoral distinctions are an indigenous feature of Mesoamerican cultures or a product of Spanish influence has been a subject of debate among scholars (Foster 1953, 1978; Furst 1995; López Austin 1988). Proponents of a Spanish influence claim that Mesoamerican hot and cold concepts derive from European concepts of humoral medicine (Foster 1953, 1978). European humoral medicine is based on four qualities: hot, cold, wet, and dry. Although Mesoamerican cultures lack wet and dry humoral distinctions, Foster (1953) claimed that these two categories were lost in the transition to New World cultures whereas the hot and cold dichotomy became established. Recent scholars have shown that this idea is untenable, and that hot and cold concepts are indigenous to Mesoamerica (Furst 1995; López Austin 1988:272). In Mesoamerican societies, hot and cold distinctions are not limited to medicine, as they are in Europe, but serve as criteria for characterizing the universe and social relations (López Austin 1988:272). For instance, many modern Maya groups, such as the Tzotzil, associate heat with personal power (Vogt 1976:206-207), a concept that likely has deep roots in Maya prehistory. Furthermore, classifications based on hot and cold categories are a feature of indigenous societies around the world, including cultures not subjected to extensive European influence, and may be the result of cross-cultural observations of the body’s reaction to physical phenomena (Furst 1995:123). Thus, hot and cold distinctions were likely indigenous to both Mesoamerican and European societies. Lastly, there is no convincing reason to explain why European wet and dry categories were not accepted by Mesoamerican cultures because a system based on the number “4” would have been in harmony with native Mesoamerican ideas of a quadrilateral universe (López Austin 1988:275).

### Iconographic and Archaeobotanical Evidence of Ancient Maya Ritual Plant Use

The ritual use of plants has a long history in Maya society. Iconographic studies have been one of the most extensive sources on ancient Maya ritual plant use, although actual identification of plants depicted is often problematic. Archaeobotanical remains from prehistoric ceremonial contexts are limited but generally support iconographic evidence for the ritual utilization of plants. Interpretations of the significance of plants depicted in ancient Maya art and botanical remains recovered from ceremonial deposits are drawn from information contained in the ethnographic and ethnohistoric record of

the Maya, known as the direct historical approach. This approach has allowed scholars to better understand the nature of plant symbolism and ritual among the ancient Maya.

Food offerings are a common theme surrounding the ritual and symbolic use of plants by the prehistoric Maya. Food in various forms was offered to ancestors and deities, especially gods that controlled the natural elements of the earth. Ethnographic data indicate that, along with prayers, food offerings are one of the essential components of Maya ritual (Redfield and Villa Rojas 1934:128). Through ritual, the gods are invited to consume the “soul” of the food (Boremanse 1993:335). Among the Yucatec Maya, foods offered to the gods are consecrated and holy; “they signify the purity of that which is set apart for divinity” (Redfield and Villa Rojas 1934:129).

Ethnographic accounts of food offerings reveal that they are perceived to be symbolic “payments” to the gods (Boremanse 1993:336). During rituals undertaken prior to planting one’s milpa, foods are offered to earth deities in order to ask for their assistance for a productive harvest (Redfield and Villa Rojas 1934:133; Vogt 1976:55). Post-harvest rituals are undertaken to compensate the gods of the earth for the use of their domain. Among the Lacandon Maya, the fruits of all cultivated plants and trees are offered after harvest (Boremanse 1993:334). After the gods have consumed these “first fruits” the community may then eat the products of the harvest. For the Tzotzil Maya, such offerings are necessary to secure successful harvests in



Figure 2.2. Kan sign representing *wah*, or tamale offering (redrawn from Coe 1973:70).

the future (Vogt 1976:56-57). It is believed that misfortune, such as drought, destructive winds, illness, or death, will result if one fails to make appropriate offerings to the earth gods.

Sacred breads are a common food offering depicted in ancient Maya art. The ritual use of sacred breads is

observable in ethnographic records (Love 1989; Love and Castillo 1984; Redfield and Villa Rojas 1934:129; Tozzer 1941:114). In Maya art and hieroglyphs sacred breads, most likely made of maize, appear as glyphs representing *wah*, meaning tamale, tortilla, or food. Glyphs that have been deciphered as *wah* include the *kan* sign, T506 in Thompson's (1962) designation (Love 1989; Taube 1989b). According to Taube (1989b), *wah* signs refer specifically to maize tamales. Depictions of tamale offerings in pre-Columbian Maya iconography and codices are abundant (Figure 2.2).

At Blue Creek, located in northwestern Belize, recent archaeobotanical research on phytoliths from several Late Formative period and Early Classic period ceremonial caches substantiate the iconographic significance of tamale offerings (Guderjan 2000). Phytoliths from *Heliconia* sp., a plant in the banana family (Musaceae), maize, squash, palms, and agave were recovered. Modern Maya groups use both maize husks and *Heliconia* leaves to wrap tamales, and squash seeds are often ground and added to the dough.

Offerings of maize ears also appear in ancient Maya art. For instance, on the central scene on page 25 of the Codex Dresden, God K is shown sitting in front of a vessel containing a maize ear. A vessel containing a tamale is next to the maize ear offering as well. Archaeobotanical remains of maize have been found in numerous offertory deposits at Maya sites. Late Classic period caches at Copán, Honduras, contained maize kernels (Lentz 1991:272), and maize cobs and pollen have been recovered from many cave sites used during the Formative period and Late Classic period in Belize, Guatemala, and Honduras (Brady 1989; Brady 1995; Brady et al. 1997b; Goldstein and Prufer 1999; Rue et al. 1989). At Lamanai, located in northern Belize, researchers recovered a high concentration of maize pollen from a possible harbor that was radiocarbon dated to 1500 B.C. Pendergast (1998:56) interprets these data as evidence that whole maize plants were tossed into the water as an offering, though it is possible that the pollen reflects local agricultural practices.

Iconographic data suggest that sacks containing harvested maize may have been associated with sacred bundles (Taube 1985:177-178), containers or wrappings of textiles that held ritual paraphernalia. Cultures throughout Mesoamerica and the Southwest United States often include ears of maize in sacred bundles (Stenzel 1969). The maize shown in Classic period depictions of sacred bundles may also be a metaphor for other sacred substances such as jade. By the Formative period, Mesoamerican cultures symbolically related greenstone items, such as jade and greenstone celts, with maize (Taube 1996, 2000), and jade and greenstone are a common discovery in caches, burials, and caves at ancient Maya sites. The association of maize with greenstone may represent a symbolic transformation of perishable maize valuables into non-perishable forms of wealth that could be traded over long distances in order

to increase the political and economic power of Mesoamerican rulers (Taube 1996:71).

The ancient Maya offered a number of non-edible botanical items to deities. Although these items are not "foods" in the technical sense, many may have been perceived as symbolic food. Prevalent symbolic food offerings of the ancient Maya include flowers and the burning of copal incense and tobacco. The fragrance of the flowers and the aroma of the smoke from burned offerings represented the "breath-soul" or *ch'ulel* of both the offering and the gods (Houston and Taube 2000:267; Taube 2002:6). In order for the deities to consume an offering's soul, it had to be converted to its spiritual, fragrant essence. Flowers, which are inherently aromatic, did not have to be physically converted, but other offerings, such as incense, had to be burned. This practice is not limited to non-edible offerings but extends to many edible food offerings and other offerings. For instance, archaeobotanical remains of maize from caches and caves are charred, indicating that Maya ritual practitioners were attempting to release the food's inner soul through fire. Also, ancient Maya blood offerings were normally burned on paper in order to transform the offering into its spiritual essence (Schele and Miller 1986:176; Taube 2002:10).

Flower motifs are common in ancient Maya iconography. The ritual use of flowers by the modern Maya, such as the Tzotzil (Vogt 1976), is well attested. The meaning behind Tzotzil Maya floral offerings reflects broader beliefs about the universe and the structure of reality. Throughout Mesoamerica's history and prehistory, flowers had multiple connotations, such as the sun, the soul, fertility, creation, and death (Bye and Linares 2001:270; Houston and Taube 2000:267-273). As just discussed, the aroma of flowers represented the fragrant "breath-soul" that was consumed by gods (Houston and Taube 2000; Taube 2002). White plumeria flowers (*Plumeria alba*), known as *sak nikte'* in Yucatec, are associated both with death expressions in Classic Maya writing and with the wind (Houston and Taube 2000:267) (Figure 2.3), emphasizing its conceptual relationship with the living soul that leaves the body at death and is carried by the wind.



Figure 2.3. Classic Maya death expression, *k'a'ay u-saknich? ik'il*, meaning "it ends, his white flower-wind" (the signs for *sak* and *nich* are conflated) (redrawn from Coe and Stone 2001:62).

Flowers are often associated with deities among the contemporary and ancient Maya. The modern Lacandon Maya creator deity, *K'akoch*, created the plumeria flower from which all of the other gods in the Lacandon Maya pantheon were born (McGee 1984:182). The Classic Maya glyph for the sun, *k'in*, is a stylized, four-part flower (Miller and Taube 1993:158) (Figure 2.4), and the *k'in* sign is a characteristic trait of the Classic period and Postclassic period Maya sun god (Miller and Taube 1993:106). The Maya god of justice and revenge, *Tohil*, is linked with *Datura*, and *Chac*, the Maya god of rain, thunder, and lightning, is linked with the water lily (*Nymphaea* sp.) (Bye and Linares 2001).

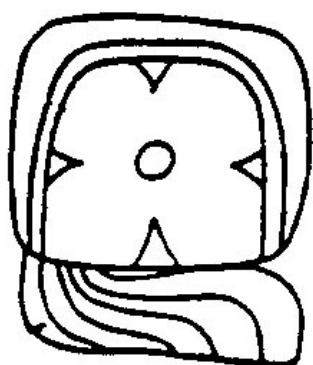


Figure 2.4. Classic period Maya day sign, *k'in*, represented as a stylized four-part flower (redrawn from Josserand and Hopkins 1993:17).

Both these plants have psychoactive properties that possibly assisted ritual practitioners in achieving altered states of consciousness (Dobkin de Rios 1974).

Archaeobotanical remains of flowers are uncommon. The fragile nature of flowers prevents the preservation of macrofloral material. Limited microfloral analysis on samples recovered from ceremonial contexts has successfully uncovered remnants of flowers, however. Palynological research conducted at Gordon's Cave III, in the Copán Valley, revealed evidence of ancient floral offerings dating from the Middle Formative period to the Classic period (Rue et al. 1989; see also Brady 1995). Ninety-nine percent of the total pollen recovered was of an unknown taxa, many composed of thousands of clustered grains representing the anthers of flowers. Although it is possible that the flower pollen was blown into the cave and represents ancient environmental conditions, the fact that this pollen type was found in all stratigraphic levels suggests that the ancient inhabitants of the region brought flowers to the cave for offerings.

Burning copal incense was an essential aspect of ancient Maya ritual, as it is among the modern Maya (Alcorn 1984:198; Breedlove and Laughlin 2000:179; McGee 1990:44; Oakes 1951:201; Redfield and Villa Rojas 1934:142; Roys 1931:277; Stross 1997; Tedlock 1982:65; Tozzer 1941:317-318; Vogt 1976:49-50; Wisdom 1940:387). Copal is commonly made from the sap of genera in the Burseraceae family or from pine (Atran and Ucan Ek' 1999:Table 2.2; McGee 1990:44;

Stross 1997; see Chapter 6). The sixteenth century Yucatec Maya cultivated copal trees, and the incense was traded over large distances (Tozzer 1941:197).

Burning copal incense was believed to be a symbolic food offering to the gods. The modern Lacandon Maya believe that burning copal transforms the incense into tortillas that are eaten by deities (McGee 1990:44). Through ritual, the Maya invited the gods to consume the fragrant smoke of the copal, which, like the aroma of flowers, constituted the offering's inner essence or soul as well as the spiritual nature of the deities (Houston and Taube 2000:271; Taube 2002:7). Censers, or incense burners, are believed to be the "kitchen hearths of the gods and ancestors" (Taube 1998:446). The burning of copal allowed Maya ritual practitioners to communicate with the gods; the burning smoke also symbolically denoted the breath or speech of the gods. Ancient Maya effigy censers were often decorated as anthropomorphized deities with a prominent mouth from which the smoke exited.

Archaeological remains of copal residue have been reported frequently from sites in the Maya Lowlands, though most scholars have not verified copal identifications through chemical analyses (see Chapters 5-6). Habitation sites that have yielded copal residue include Middle Formative period contexts at Cahal Pech (Aimers et al. 2000:75) and Cerros (Cliff and Crane 1989:Table 2), Early Classic period contexts at Tikal, Guatemala (Taube 1998:note 13), and Late Classic period contexts at Altar de Sacrificios, Guatemala (Willey 1972:248). Copal incense has also been reported from caves and cenotes, such as Naj Tunich, Guatemala (Brady 1989: 212-213), Petroglyph Cave, Belize (Reents-Budet and MacLeod 1997:60), and Rio Frio Cave E, Belize (Pendergast 1970:8). One hundred-sixty specimens of copal offerings were dredged from the Cenote de Sacrificios, near Chichen Itza, Yucatan, Mexico (Coggins and Ladd 1992). Many of the copal specimens have maize ear impressions, demonstrating the symbolic relationship between copal and food.

Tobacco (*Nicotiana tabacum*) is another plant illustrated in Classic Maya iconography. Tobacco was used in rituals and may have aided in obtaining altered states of consciousness (Robicsek 1978; Thompson 1970:103-123). Representations of tobacco often appear as cigars, possibly wrapped in maize leaves, with a double volute of fire coming from the end. The double volute motif associated with cigars is structurally similar to Classic period double volute signs that denote breath, aroma, and wind (Houston and Taube 2000:269), suggesting that the fiery smoke produced by the cigar is the soul of the offering transformed through fire for the gods' consumption. For instance, at the Temple of the Cross, at Palenque, Mexico, an aged deity is depicted smoking a cigar with a prominent double volute motif. Cigars are also found in the Madrid Codex. Cigars are involved in one of the trials of the Hero Twins in the Popol Vuh, the Quiché Maya book of creation, which likely has roots in

the Classic period (Tedlock 1985). The Hero Twins are given cigars by the Lords of the Underworld. They are told to smoke the cigars, but they are ordered to return them the next morning unburned or else they will be sacrificed as punishment. The twins place fireflies at the tips of the cigars to imitate burning and, thus, pass the test. The sixteenth century Yucatec Maya used tobacco in puberty rites (Tozzer 1941:106), and many modern Maya groups use tobacco for medicinal purposes (Arnason et al. 1980:Table 3; Atran and Ucan Ek' 1999:Table 2.2; Comerfield 1996:335; Robicsek 1978; Thompson 1946). Unfortunately, no archaeobotanical specimens of tobacco have been recovered from archaeological sites in the Maya region.

In ancient Maya society, dominant groups appropriated plants as symbols of ideological, social, political, and economic power. Incorporating plant symbols with rulership related the politically powerful with the natural forces of the universe that control life. From the Formative period to the Classic period, Mesoamerican rulers often depicted themselves with maize motifs in order to identify themselves with maize deities (Taube 1996). Maize gods were associated with the *axis-mundi*, or center of the universe, in Mesoamerican cosmology (Freidel et al. 1993; Reilly 1994; Taube 1985, 1996). The Maya also believe that maize is the source of life, and humans were made from maize dough (Tedlock 1985:163, see Chapter 3). By harnessing maize symbolism, rulers were establishing themselves as the *axis-mundi* and as the source of creation in Mesoamerican ideologies, thereby sanctifying their rule and legitimizing and reproducing social inequalities.

As discussed above, restricted access to certain foods served to establish and maintain asymmetrical social relations in ancient Maya society. Cacao (*Theobroma cacao*), chocolate, was a symbol of wealth and power for ancient Mesoamerican groups (Coe and Coe 1996). By Postclassic times, cacao beans were a source of currency, a symbol par excellence of economic inequality (Tozzer 1941:94-94). Cacao beans were given to local lords as tribute items during the Classic period. A Classic period vase from Río Azul shows a number of bundled tribute items painted with the glyphs *ka-bul*, meaning "our beans" (Foiás 2002:237), perhaps referring to cacao. Cacao and other orchard trees are depicted in the iconography of Pakal's sarcophagus at Palenque, Mexico (Robertson 1983) (see Figure 6.9). The iconography suggests an association between these trees, ancestors, and inheritance (McAnany 1995:75, see above).

Classic period art and ethnohistoric texts show that a ceremonial beverage was made from cacao. Its consumption was reserved for high status groups, especially during feasts and other ritualized, political transaction events. LeCount (2002:941-943) proposed that the consumption of cacao took place during more public social and political events in contrast to the more private nature of sacramental meals, such as the offering of foods to the gods discussed above. Landa wrote that

during sixteenth century Yucatec Maya feasts, "they give [to each guest] a roasted fowl, bread and drink of cacao in abundance" (Tozzer 1941:92). The main glyph band (Primary Standard Sequence) of many Classic period polychrome vessels states that they were cacao- drinking vessels, and some vessels depict the consumption or preparation of chocolate drinks.

Archaeobotanical remains of cacao are uncommon. Residue from a jar from an Early Classic period elite burial at Río Azul, Guatemala, was identified as cacao (Hurst et al. 1989). A number of spouted ceramic vessels, often called "chocolate pots," from Middle Formative period and Late Formative period contexts at Colha, Belize, also contained cacao residues (Powis et al. 2002), suggesting that the elite consumption of cacao was established at an early date in Maya prehistory.

Macrofloral evidence of cacao is limited. *Theobroma* charcoal has been recovered from many archaeological sites (Lentz 1999:Table 1), though some specimens may be from non-cultivated species. Cacao seeds and peduncles were found in four utilitarian vessels at Cerén, El Salvador (Lentz et al. 1996a:255-256), and recent archaeobotanical research at Aguateca, Guatemala, recovered a cacao seed from an elite structure known as the "House of Mirrors" (Dickau and Lentz 2001). Cacao seeds have also been found in cave sites in the Maya Mountains of western Belize (Keith Prufer 2001, personal communication).

In summary, there has been little systematic exploration of the ceremonial dimensions of archaeobotanical remains in the Maya area, though plant material has been collected from a number of ritual contexts. Ethnography and iconography demonstrate that plants were and continue to be salient symbols in ritual experience, providing a culturally meaningful interpretative framework for the present study. The symbolic attributes of plants, rather than simply their economic utility, are key criteria in the use of plants in modern Maya rituals. This practice extends deep into Maya prehistory. Iconographic, epigraphic, and archaeobotanical data indicate that many plants used during rituals were believed to be food offerings to the gods and ancestors. Food offerings consist of "real" foods, such as maize, and "symbolic" foods, such as copal incense and tobacco. These offerings are today perceived as payments or compensation to the deities. By offering payments of foods to the gods, the Maya were attempting to prevent misfortune and to maintain a successful way of life.



## CHAPTER 3

### CAVES IN ANCIENT MAYA SOCIETY

In this chapter, I hope to show that caves were sacred areas of the natural landscape for the ancient Maya. I propose that Maya cave archaeology provides an opportunity to explore the symbolism of plants in prehistoric Maya ceremonial experience. First, however, the function of caves as ritual contexts must be established. This chapter outlines the history of Maya cave archaeology, demonstrating how cave archaeology has progressed from a casual undertaking with an emphasis on caves as habitation sites to a scientific endeavor that recognizes caves as ritual contexts. This overview, however, can do little more than offer an overview of Brady's (1989) comprehensive review. Information drawn from ethnography, ethnohistory, iconography, and epigraphy sheds light on the dominant themes associated with caves in Maya society. These themes reveal that caves represent transitions between cosmological states such as earth and underworld, night and day, and life and death.

#### Early Studies of Ancient Maya Cave Use

The study of ancient Maya cave utilization began as sporadic reconnaissance and recording of general observations by early prehistorians. Many of these efforts did not produce site maps or adequate inventories of artifactual material, and caves were usually described as habitation sites (Brady 1989). One of the earliest, extensive reports on caves in the Maya region was Henry Mercer's (1975) *The Hill-Caves of Yucatan*. This work is a summation of survey and excavations conducted by Mercer in the 1890s at 29 cave sites in the Yucatan peninsula. Mercer, however, interpreted these cave sites as dwelling places of the prehistoric Maya.

Edward Thompson was another early investigator who explored and documented a number of cave sites in the Yucatan, including Loltun Cave (Thompson 1897). Thompson's research at Loltun Cave is noteworthy because he provided maps and drawings and descriptions of cultural remains. The Cenote of Sacrifice at Chichen Itza is a well-known site where he began a dredging project between 1904 and 1907 (Thompson 1965). The artifacts from the Cenote of Sacrifice include ceramics, wooden and metal artifacts, copal, rubber, textiles, basketry, and human and faunal remains (Coggins ed. 1992). The archaeological work at the Cenote of Sacrifice emphasized the ceremonial role of subterranean loci in the Maya landscape and provided empirical support for the ritual use of cenotes described in ethnohistoric records, such as *Landa's Relación de las Cosas de Yucatan* (Tozzer 1941), which feature people, particularly children, thrown into cenotes as sacrificial victims to rain gods.

Other early studies on caves in the Maya region include George Gordon's (1898) documentation of a number of

caves in the Copán Valley of western Honduras, and Eduard Seler's (1901) investigations of caves in the Guatemalan highlands (Brady 1989:13-14). Gordon reported on five caves in the Copán Valley, including Gordon's Cave III. Gordon's Cave III is significant because excavations yielded abundant human remains, suggesting to Gordon that the site may have been the locus of ceremonial activity involving a cave cult (Gordon 1898:10). Gordon's Cave III is of particular interest also because it was the subject of more recent archaeological study in the late 1980s and early 1990s (Brady 1995; Rue et al. 1990), allowing archaeologists to re-evaluate Gordon's observations using new methodological approaches and interpretative perspectives. Seler's work is noteworthy because it is one of the first documentations of caves in the Maya highlands, particularly near the site of Quen Santo.

Following these very early studies, reports of caves in the Maya region became more frequent. As Brady observes (1989:16), however, many of these caves are poorly documented, and some investigators continued to think of caves as habitation sites. Archaeologists described several caves in Mesoamerica, particularly in Belize, including Thomas Gann (1918, 1925), Thomas Joyce (1929; Joyce et al. 1928), J. Eric Thompson (1939), and Gregory Mason (1928). These reports demonstrate early archaeologists' awareness of caves as rich repositories of cultural material, providing a historical foundation for later studies. On the other hand, systematic descriptions of artifact collections were infrequent, and little effort was made to synthesize cave data into a broader understanding of ancient Maya cave utilization or into the wider realm of Maya prehistory in general (Brady 1989:19-20).

Great strides in viewing caves as significant archaeological sites followed J. Eric Thompson's *The Role of Caves in Maya Culture* (1959, 1975). Thompson outlines numerous uses of caves by the Maya, including as sources of drinking water and sacred water (*suhuy ha'*, or virgin water), loci for religious rites, ossuaries, and the disposal of ceremonially utilized utensils (see also Brady 1989:32). Unlike previous studies, Thompson recognized the ritual nature of ancient Maya cave utilization.

The quality of archaeological reports on caves improved during the 1960s and 1970s. Archaeologists began to produce accurate site maps and descriptions, and artifacts were accurately recorded, often with drawings and photographs. In Yucatan, Mexico, E. Wyllys Andrews IV conducted investigations at caves near the site Dzibilchaltun, such as Balankanché (Andrews 1970) and Gruta de Chac (Andrews 1965). Andrews noted the relationship between the caves and Dzibilchaltun, carefully documented the artifactual assemblages, and made observations concerning the religious significance of natural features of the caves' morphology, notably a stalagmitic column at Balankanché where a high density of ceramic vessels with *Tlaloc* appliqué decorations were recovered (Andrews 1970:19). Andrews also recognized

the ceremonial nature of ancient cave activity and, at Balankanché, recorded a ritual conducted by modern Yucatec shamans in the cave (Andrews 1970:72-164).

David Pendergast is another archaeologist who produced detailed site reports on caves during the 1960s and early 1970s. Pendergast's research was conducted in central and western Belize. Pendergast investigated several caves, including Actun Balam (Pendergast 1969), Rio Frio Cave E (Pendergast 1970), Eduardo Quiroz Cave (Pendergast 1971), and Actun Polbiche (Pendergast 1974). Pendergast's work is exemplary for several reasons. He provided careful descriptions of the sites' locations and surrounding environmental characteristics, included accurate site maps, discussed excavation methodologies, and thoroughly described and illustrated artifacts and discussed their comparative aspects with known specimens from habitation sites. In other words, Pendergast applied the same archaeological research techniques used at other archaeological sites (Brady 1989:25). Pendergast also brought more specialized archaeological disciplines into the study of cave assemblages, specifically archaeobotany and zooarchaeology (Pendergast 1971:78-111; 1974:61-79). Numerous modified and unmodified botanical data were identified at Actun Polbiche, and faunal material was identified from Actun Balam, Eduardo Quiroz Cave, and Actun Polbiche (see also Pohl [1983] for a re-examination of fauna material from these caves).

### Modern Models of Ancient Maya Caves as Ritual Sites

Since 1950, archaeological reporting of caves in the Maya region has increased (see Brady 1989:26). The growing attention to cave sites with more advanced archaeological techniques has allowed researchers to better understand cave assemblages and to make broader inferences about the role of caves in ancient Maya society. A problem of earlier studies is that there was no attempt to develop research questions that could appropriately address caves (Brady 1989:7). In addition, cave data were not integrated in order to make such inferences possible, and the assumption that caves were habitation sites continued. This situation led Brady (1989) to propose a paradigm that emphasizes the ceremonial nature of archaeological contexts encountered in caves. Brady (1989:7) proposes Maya cave archaeology as a unique sub-field of Maya studies that is specifically oriented toward understanding highly specialized, ritual contexts using iconographic, epigraphic, ethnohistoric, and ethnographic data to construct explanatory frameworks. In order to understand the role of caves in Maya prehistory, archaeologists must employ information from related disciplines. The integration of archaeological data with inferences drawn from analogous data in these separate fields provides the foundation for all modern cave research.

Ethnohistoric and ethnographic data on Maya perceptions of caves and other subterranean features are common, and iconographic representations of these areas are abundant.

In the Popol Vuh, the Highland Quiché Maya book of creation, the subterranean world is associated with the Underworld, known as *Xibalba* (Tedlock 1985). The Popol Vuh describes *Xibalba* as a frightening place, inhabited by powerful deities that were associated with death and disease (Tedlock 1986:106-108). In the Popol Vuh, *Xibalba* is the location of a contest between ancestral deities, the Hero Twins, and the Lords of *Xibalba*, thereby emphasizing a struggle between the structural elements of life and death. In this story, One *Hunahpu* and Seven *Hunahpu*, the sons of the creator gods *Xpiyacoc* and *Xmucane*, are tricked and sacrificed by the lords of the Underworld. They are buried at the Place of Ball Game Sacrifice, and One *Hunahpu*'s head is placed in the fork of a calabash tree. When the sons of One *Hunahpu*, *Hunahpu* and *Xbalanque*, are born, the Lords of *Xibalba* also lure them to the underworld to play a ballgame. The two sons are not tricked by the Lords of *Xibalba*, however, and defeat them. The two brothers go to the Place of Ball Game Sacrifice, resurrect their father, and promise him that human beings will come to pay homage for eternity.

Ethnohistoric documents recorded rituals that were conducted at caves and cenotes, where the Maya worshipped idols and left offerings and sacrifices (Tozzer 1941:75). In 1562, the discovery of a sacrificed deer, altars, incense, and idols in a cave in Yucatan, Mexico, was the primary factor in the implementation of an Inquisition, or *auto de fe*, in which many Yucatec Maya were interrogated, tortured, and killed (Tozzer 1941:76). For the sixteenth century Yucatec Maya, the underworld was known as *Metnal* (Tozzer 1941:131-132). It was a place of torment for the souls of people who led a bad life. The ruler of *Metnal*, *Hunhau*, is referred to as "the prince of all the devils" in ethnohistoric texts of the Yucatec Maya (Tozzer 1941:132). Ethnohistoric and modern Yucatec sources refer to caves as sources of disease (Redfield and Villa Rojas 1934:164; Roys 1965). Although early ethnohistoric accounts are biased by Christian teachings and the Catholic agenda of Spanish chroniclers, parallels between the Highland Quiché and the Lowland Yucatec are apparent. Both groups perceived the underworld as a frightening place inhabited by powerful deities, and both accounts reveal the existence of the same central underworld figure, One *Hunahpu* or *Hunhau*. The two names are cognates and, thus, likely refer to the same deity.

Scholars have found parallels of underworld figures discussed in ethnohistoric texts, particularly One *Hunahpu*, in the iconography and epigraphy of the Classic period (Freidel et al. 1993; Taube 1985). The Classic period form of One *Hunahpu* is *Hun Ahau*, meaning "First Lord" or "First Father." After the Lords of *Xibalba* sacrificed *Hun Ahau*, he was by was resurrected by his sons as the Maize God, *Hun-Nal-Ye* (Freidel et al. 1993:55, 276; Taube 1985:175). Classic period art often depicts the Maize God's birth from a fissure in the earth's surface (Taube 1985:175) (see Figure 6.7), and representations of the Maya World Tree

are sometimes in the form of a maize plant emerging from the underworld (Freidel et al. 1993:53).

The belief that maize originated in a subterranean region has a long history, and many modern Maya groups share this belief (Thompson 1970:348-354). The Mopan, Mam, and Tzeltal Maya have myths that place the origin of maize within the earth, often explicitly designated as in caves. The Mopan Maya of San Antonio, Belize, and the Mam Maya of Colotenango, Guatemala, believe that the first maize was found beneath a rock or in a hole in a rock, stressing its subterranean origin. Similarly, the Tzeltal of Tenejapa, Mexico, hold that God obtained maize from ants that had taken it from *anheles* (caves, hills, or springs).

In the Popol Vuh (Tedlock 1985:163), One *Hunahpu*'s mother, *Xmucane*, created the flesh of the first humans from maize dough. Because maize originated in the underworld, this act emphasizes the relationship between the underworld and the source of life: maize. The association between the creation of humans and the underworld is more explicitly referenced in the Popol Vuh by the actions undertaken by *Xmucane* herself (Tedlock 1985:163). *Xmucane* ground the maize for the first humans nine times. The number nine is significant because the underworld is often described as having nine layers (Bassie-Sweet 1996:51; Thompson 1950, 1970), and paintings of the number nine (in Maya bar and dot numerals) have been found on the walls of caves in the Maya regions, including Naj Tunich, Guatemala (Stone 1995:150).

There are numerous other sources that associate caves and subterranean regions with ancestral figures and concepts. The Tzotzil of Highland Mexico hold that the god *Manohel-Tohil* led the first people out of caves and provided them with bodies and souls (Brady 1989:53; Thompson 1970:202). The Chontal Maya have a myth of a boy with super-human powers who was born in a cave (Turner 1972:82-83). The boy was forced by his godfather to pass a number of trials, illustrating the myth's similarities with aspects of the Popol Vuh. Each modern Tzeltal Maya settlement is associated with a cave, and both caves and settlements share the same name (Villa Rojas 1947:580, cited in Bassie-Sweet 1996:161). Among the Tzotzil of Zinacantan, Mexico, groups of lineages are associated with waterholes that are formed by natural springs emanating from caves or fissures (Vogt 1976:99). These waterhole groups have myths about ancestors who found the water and secured its use for their descendents. Waterhole groups retain their use-rights by maintaining the waterholes through cleaning and proper rituals. For the Tzotzil, caves and mountains are also dwelling places of ancestral figures and powerful deities, and frequent rituals are conducted at shrines dedicated to them (Vogt 1969:388). The Maya of Amatenango, Guatemala, also believe that caves are the home of ancestors, and annual ceremonies are practiced at their entrances (Nash 1970:23). The worship of ancestral human bones in caves has also been observed

among many Maya groups (Bassie-Sweet 1996:160-161). For the Lacandon of Chiapas, Mexico, caves are sacred shrines, and human remains are curated at their entrances (McGee 1990:57).

Researchers have noted a number of associations between cave rituals and concepts of fecundity. As discussed above, maize is believed to have originated in caves among numerous modern Maya groups, and iconography demonstrates that this perception was held during the Classic period. Maize is the ultimate symbol for agricultural productivity and life itself. There are a number of other references that relate caves to notions of agricultural fertility as well. For the Tzotzil of Zinacantan and Chamula, Mexico, caves are the domain of the Earth Lord, *Yahval Balamil* (Vogt 1976:16-17). The Earth Lord is described as a greedy Ladino who controls the clouds that produce lightning and rain and owns all the products of the earth. Agricultural rites are conducted in order to repay the Earth Lord for the use of materials in his domain (Vogt 1976:56). The Tzeltal of Pinola, Mexico, believe that powerful deities associated with thunder and wind reside in caves (Hermitte 1964:49). Among the Yucatec (Redfield and Villa Rojas 1934:205) and Lacandon Maya (McGee 1990:7), caves and cenotes are dwelling places for *chacs*, or traditional rain deities (Thompson 1970:251-270), and the sixteenth century Yucatec Maya sacrificed young girls in cenotes in order to appease rain gods (Tozzer 1941:223). The word *chac* itself is a cognate of *cauac*, meaning lightning or storms (Bassie-Sweet 1996:56), and *cauac* symbolism is associated with caves (see below). Human remains, some possible sacrifices, have been recovered from cenotes and caves throughout the Maya region, suggesting that this practice had a long history (Brady 1989, 1995; Brady et al. 1997; Gibbs 2000; Hooton 1940; Owen 2002; Pendergast 1971; Pohl and Pohl 1983; Reents-Budet and MacLeod 1997; Thompson 1959, 1975).



Figure 3.1: Drawing 18 at Naj Tunich depicting the moon goddess copulating with an aged male god (redrawn from Brady 1989:Figure 3.2).

Brady (1988, 1989:42-53) has interpreted the erotic symbolism of artwork found in caves, such as Naj Tunich, Guatemala, as representing notions of fertility. For instance, Figure 3.1 shows the moon goddess copulating with an aged male deity in a pictograph from Naj Tunich (Brady 1989:Figure 3.2; Stone 1995:Figure 6.28). The moon goddess is the patroness of childbirth for many Maya groups (Thompson 1970:241-243). The moon goddess is also associated with *Xmucane*, the Popol Vuh female creator deity (Freidel et al. 1993:61). Erotic themes are commonly related to reproduction and fecundity among the modern Maya, and there are numerous parallels between caves and eroticism. For the Tzotzil Maya, the word *c'en*, cave, is also used to connote a vagina (Bricker 1973:65-66; Laughlin 1975:132). According to Hunt (1977:107-109), caves represent both wombs and vaginas in Tzotzil Maya myths concerning caves of origin.

Artifact assemblages recovered from caves in the Maya region suggest possible rites conducted in honor of rain and agricultural deities. Manos and metates (ground stone tools used to grind maize flour into dough) have been found in abundance at caves in Mexico (Andrews 1970), Belize (Griffith 1998; Moyes and Awe 1998; Pendergast 1969, 1971; Reents-Budet and MacLeod 1997), and Guatemala (Brady 1989). Also, burned maize cobs have been found at caves in Guatemala (Brady 1989; Brady et al. 1997), Belize (Goldstein and Prufer 1999), and Honduras (Brady 1995).

Modern Maya groups also associate caves and the underworld with astronomical cycles, particularly the daily course of the sun and the moon. Sosa (1986:193) has noted that for many Maya groups, the elliptical path of the sun ascends from the underworld in the east, and Yucatec shamans hold that a cave on the eastern horizon is where the sun emerges each morning. When the sun sets, the Quiché believe that “the sun finally ‘dies’ and ‘goes into’ the earth...bringing back darkness” (Earle 1986:158). Similarly, Villa Rojas (1945:156, cited in Bassie-Sweet 1996:63) observed that when the sun and the moon set in the west, they enter a subterranean passage. The Hero Twins of the Popol Vuh are also associated with the sun and the moon (Freidel et al. 1993:110-111; Tedlock 1985:46). Because the daily paths of the sun and moon are inversely related, the Maya believe that when it is day on the earth’s surface it is night in the underworld (Gossen 1974:22).

Representations of caves and the underworld are common themes in the iconography and epigraphy of the ancient Maya. As previously discussed, there are numerous depictions of the Maize God emerging from a fissure in the earth’s surface. Fissures and openings symbolized access points to the underworld, such as caves and cenotes (Bassie-Sweet 1996:63-110). There are a number of such signs, including skeletal jaw motifs, cenote signs, and quatrefoil openings. A well-known example of the skeletal jaw motif is found on Pakal’s sarcophagus at Palenque, Mexico (Figure 3.2). Pakal is depicted falling

into the skeletal jaws of the underworld, initiating the journey that begins with death and continues in resurrection (Freidel et al. 1993).

Signs representing cenotes are similar structurally to the skeletal jaw motif. The Uayeb month sign is a common example of a cenote sign (Figure 3.3)

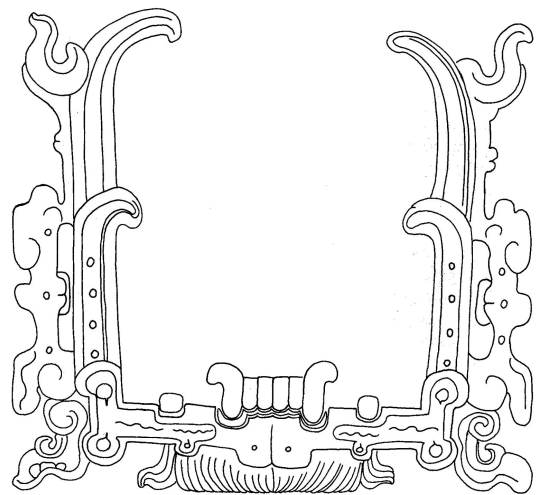


Figure 3.2: Skeletal jaw motif of Pakal’s sarcophagus lid (redrawn from Bassie-Sweet 1996:Figure 31).

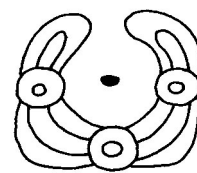


Figure 3.3: Cenote sign (adapted from Bassie-Sweet 1996:Figure 32a).

(Bassie-Sweet 1996:91). The Uayeb sign contains a profile of the open edges of a cenote, often with a dot, representing the sun or moon, in its interior. The *Uayeb* is part of the Maya solar calendar, the *Haab*, which is composed of 18 periods of 20 days. The *Uayeb*, a period of five days, is added at the end so that the *Haab* corresponds more closely to a solar year of 365 days (Josserand and Hopkins 1993:18). The *Uayeb* is perceived as an unlucky and dangerous time before the initiation of the New Year and is characterized by ritual observances. Ethnohistoric accounts of the Colonial Yucatec reveal that the *Uayeb* was considered a period when the underworld was open (Taube 1989a:352).

Quatrefoil cartouches are another prehistoric motif associated with caves and openings to the underworld (Bassie-Sweet 1996:66). Quatrefoils are often shown related to ancestral figures and ideas. For example, quatrefoil cartouches frame ballplayers on the ballcourt markers at Copán, Honduras, suggesting a relationship to the mythological story of the Hero Twins in the Popol Vuh (Tedlock 1985) (Figure 3.4), and at Palenque, Pakal’s ancestors are depicted emerging from quatrefoil



Figure 3.4: Markers from Ballcourt II-B, Copan, Honduras, in shape of quatrefoils framing ancestral ballplayers. Left to right: North Marker, Center Marker, South Marker (redrawn from Josserand and Hopkins 1990:30).

motifs. Looper (2000) has proposed that the quatrefoil T510c and T510d (Thompson 1962:108-110, 452) signs are logographs for *ch'en* or *ch'é'en*, meaning “cave” in many Mayan languages.

Other aspects of cave symbolism are prevalent in the iconography and epigraphy of the ancient Maya. The elements of the T528 *Cauac* day sign (Thompson 1962:134-143, 452) are representations of cave features, such as a profile of a cave’s entrance with a stalactite hanging from its ceiling and a pool of water at its base



Figure 3.5: *Cauac* sign incorporating cave features, such as a drip-water stalactite and a pool of water (redrawn from Bassie-Sweet 1996:17a).

(Figure 3.5). The cave symbolism of the *Cauac* sign appears in many forms in Classic period iconographic assemblages, including as mountains, as zoomorphic figures, or *Cauac* monsters, and in quatrefoils (Bassie-Sweet 1996:66-69). The T510c and T510d signs, read as *ch'en* or *ch'é'en* by Looper (2000, see above), are quatrefoils containing elements found in *Cauac* signs, particularly the drip water stalactite motif, and other representations of quatrefoils with *cauac* symbolism have been noted (Bassie-Sweet 1996:68-69, 82). A variant of the T528 sign, the T529 glyph (Thompson 1962: 143, 452), has been read as *witz* (Stuart 1987), or mountain,

suggesting a relationship between caves and mountains—an association made by modern Maya groups (Bassie-Sweet 1991:80).

Another hieroglyphic representation of caves is the T598 (Thompson 1962:223-224, 453) “impinged bone” sign (Figure 3.7). This sign is framed by a cave’s profile, as in the T528 glyph. The sign’s interior is separated into light and black halves with an element representing a bone in the center, midway between the two halves. The bone element is often depicted as a fleshless lower jaw, similar to the skeletal jaw motif discussed above. The “impinged bone” glyph has recently been proposed as a logograph for *ch'en*, or cave (Stuart et al. 1999). It is often found associated with place-names, indicating that it may have functioned as a locative sign (Bassie-Sweet 1996:95; Stuart and Houston 1994:12-13). Thus, in many contexts, the appearance of the “impinged

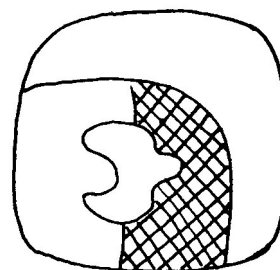


Figure 3.7: T598, the “impinged bone” sign illustrating the profile of a cave, and a central bone motif. The sign is separated into light and black halves, reminiscent of the transitional location of caves in Maya cosmology (redrawn from Bassie-Sweet 1996:Figure 33).

bone” sign likely references a particular cave, perhaps analogous to the ancestral caves of the modern Maya.

### The Ritual Context of Caves

The dominant theme throughout the variable meanings assigned to caves in Maya ethnography, ethnohistory, iconography, and epigraphy, is that caves are cosmological thresholds, a “sacred boundary between two spaces” (Bourdieu 1977:130). Caves are access points to the underworld for Maya people and points of access to the earth for underworld deities (Bassie-Sweet 1991, 1996). Thus, caves represent transitional loci between two cosmological realms. As such, the meanings of caves appear as structural dualities. For example, caves are described as dwelling places of ancestral figures, and the first humans were made from maize, which itself originated in a cave. The underworld, however, is also described as the source of death and disease by the post-Conquest Maya, and death motifs related to caves are depicted in Classic period artwork and hieroglyphs, such as the skeletal jaw and the “impinged bone” sign. Further, the modern Maya hold that the sun and the moon emerge from a cave, and when it is day on earth, it is night in the underworld. Douglas (1966) has observed that such transitional states are often perceived as dangerous and

polluting by societies around the world. Thus, the Maya believe that eclipses are dangerous and unnatural occurrences (Oakes 1951:56; Redfield and Villa Rojas 1934:206-207). This perception is due to the merger of two structurally opposite spheres into one: night and day and life and death.

Because caves occupy a transitional and marginal position in Maya cosmology, they can be characterized as liminal realms. Turner (1969:95) describes liminality as a structurally ambiguous condition that is “neither here nor there...betwixt and between...law, custom, convention, and ceremonial.” Liminal states are characteristic of rituals in many cultures. For the Maya, liminality is not restricted to ceremonial activities involving caves, but it is a general attribute of ritual experience. During most Tzotzil rituals, symbolic associations dictate the selection and arrangement of ceremonial paraphernalia (Vogt 1976). Thus, for instance, certain plants are used because they are considered wild, and others are used because they are considered domesticated, emphasizing the contrast between nature and culture (Vogt 1976:66-72). Their placement during ceremonies establishes the boundaries of the ritual space as an enclosed liminal realm.

Liminality is an aspect of rites of passage. Rites of passage are composed of three stages (van Gennep 1960): separation, margin, and aggregation. During separation, an individual is symbolically detached from the social structure. The individual then passes through the second stage, margin or liminality, which is devoid of any characteristics of the past or future states (Turner 1969:94). In the last stage, the individual returns to a stable state and is reincorporated into the structure of society, often with new status and obligations.

Due to the cyclical nature of Maya cosmology (Miller and Taube 1993:48-54), rites of passage characterize the cultural meaning of rituals involving caves and the underworld in Maya society. For instance, the sun enters the underworld during the night, but it reemerges from a cave the next dawn. When one dies, he or she is eventually reborn to a new life, just as One *Hunahpu* was killed by the Lords of *Xibalba* and resurrected by the Hero Twins (Tedlock 1985). By entering a cave or establishing the boundaries of a ceremony with cave symbolism, ritual practitioners enter sacred, liminal realms—transitional between two structured states.

## Summary

There is a growing body of evidence to support the view that the Maya utilized caves primarily for ceremonial purposes rather than for habitation sites, an assumption made by early researchers. Caves are shown to be the dwelling place for deities associated with the earth. Thus, ceremonies were conducted at caves in order to appease gods for rain and a productive harvest. The dominant structural themes associated with caves from ethnography, ethnohistory, iconography, and epigraphy

indicate that caves represented transitional realms that exist between two structured states, such as earth and underworld, life and death, and night and day. Such liminal spheres are associated with ritual and symbolic experience.

## CHAPTER 4

### ENVIRONMENTAL AND CULTURAL SETTING OF CAVE UTILIZATION IN THE UPPER BELIZE VALLEY

This chapter presents the environmental and cultural setting of cave utilization in the Upper Belize Valley. First, the ecological, cultural, and political history of the region is outlined. The Upper Belize Valley was the site of considerable occupation throughout Maya prehistory. As early as the Formative period, the region utilized rivers as avenues of trade between the Caribbean coast and the interior. During the Classic period, this location on significant trade routes together with opportunities for intensive agriculture in the alluvial floodplains and fertile foothills facilitated the rise of a politically complex social landscape. By the Late Classic period, there is substantial evidence for cultural influence from large polities located in western Petén, Guatemala, especially from the site of Naranjo, suggesting that Naranjo dominated the centers of the Upper Belize Valley in a decentralized political organization. The Upper Belize Valley was influenced by broader social, political, and environmental stresses affecting the entire southern Maya Lowlands during the Late Classic and Terminal Classic periods (ca. A.D. 600-900 [1000]). Such instability promoted a climate of competition and conflict among the political entities of the Upper Belize Valley. Second, the role of caves in the Maya Lowlands is discussed. The ancient Maya likely reacted to social, political, and environmental stress by increasing ceremonial activities in caves. Due to the heightened conflict in the southern Maya Lowlands during the Late Classic period, I hope to show that the utilization of caves served political goals. Groups struggling for power attempted to appropriate sacred symbols of Maya cosmology in order to compete with one another and to establish an ideology that legitimized their dominance. This perspective on the use of caves provides an interpretative background to understand the nature of cave rituals in the Upper Belize Valley. Lastly, the environmental and cultural settings and individual site descriptions of the cave sites presently under investigation are presented.

#### **Environmental and Cultural Setting of the Upper Belize River Valley**

The Upper Belize River Valley, Cayo District, Belize (Figure 4.1), is the region surrounding the western-most point of the Belize River. It is a topographically and vegetationally diverse area. The Belize River, the largest river system in Belize, flows east from western Belize into the Caribbean Sea. The river is formed north of the modern town of San Ignacio by the confluence of its two major branches, the Mopan and Macal Rivers, which drain waters from the Maya Mountains and swampy areas of Petén, Guatemala (Wright et al. 1959:24).

Geologically, the Upper Belize River Valley consists of a series of low-lying alluvial terraces that are bounded by

upland terrain. The regions north and south of the Belize River display geomorphological and environmental differences. North of the Belize River, the region is divided into a more mountainous zone of limestone hills west of the confluence of the Macal and Mopan Rivers and an area dominated by open valleys and plains to the east (Fedick 1989:217-218, 1995:18; Ford and Fedick 1992:36). Turner (1978:166-167) divides this area into the northern ridge lands and the flat lands respectively. The northern ridge lands extend northwest from the convergence of the Mopan and Macal Rivers into Petén, Guatemala, and eventually terminate in southeast Campeche and southwest Quintana Roo, Mexico. The flatlands extend east until they compose the majority of the land patterns in central and northeast Belize. The southern portion of the Upper Belize River Valley, termed flank lands by Turner (1978:167), is physiographically similar to the northern ridge lands except that elevation and slope increase as one approaches the Maya Mountains, an undifferentiated block of sedimentary rock that formed during the Paleozoic era.

The vegetation of the Upper Belize River Valley is variable depending on elevation, proximity to water, and soil characteristics. Overall, the general pattern conforms predominantly to the Subtropical Moist Forest Life Zone (Fedick 1995:19; Ford and Fedick 1992:36; Smith 1996), also called a High Ridge (Horwich and Lyon 1990:65). This pattern of vegetation is composed primarily of deciduous, seasonal, broadleaf forests rich in lime-loving species. In addition, pine ridges that extend north from the Mountain Pine Ridge characterize the foothills of the upper Roaring Creek and Barton Creek valleys. Soils in the Upper Belize River Valley grade from more fertile, alluvial sediments along the valley bottom (Fedick 1995:19) to fertile, calcareous soils with a higher susceptibility to erosion in the valley uplands (Turner 1978:168). Rainfall in this region is seasonal. The wet season begins in May, though May rains are unpredictable, and continues until January (Wright et al. 1959:183; Fedick 1995:19). The average maximum rainfall during the wet season is approximately 250 mm per month. The dry season begins about mid-January and continues until the end of April. Maximum monthly rainfall during the dry season generally does not exceed 25 mm.

Numerous prehistoric Maya settlements are distributed over the Upper Belize Valley's landscape, from large centers, such as Xunantunich, Cahal Pech, Buena Vista del Cayo, El Pilar, and Baking Pot, to small, outlying hamlets and isolated mounds (Figure 4.1). Abundant caves and rock shelters that were utilized by the Maya also mark the karst, limestone topography. Settlement was initiated by the Middle Formative period (ca. 1000-300 B.C.) at such sites as Las Ruinas de Arenal (Ball and Taschek 1999), Pacbitun (Healy 1999, Healy and Awe 1996), Barton Ramie (Willey et al. 1965), Baking Pot (Bullard and Willey 1965), Cahal Pech (Awe et al. 1990; Healy 1999), and Blackman Eddy (Brown 1998) (see

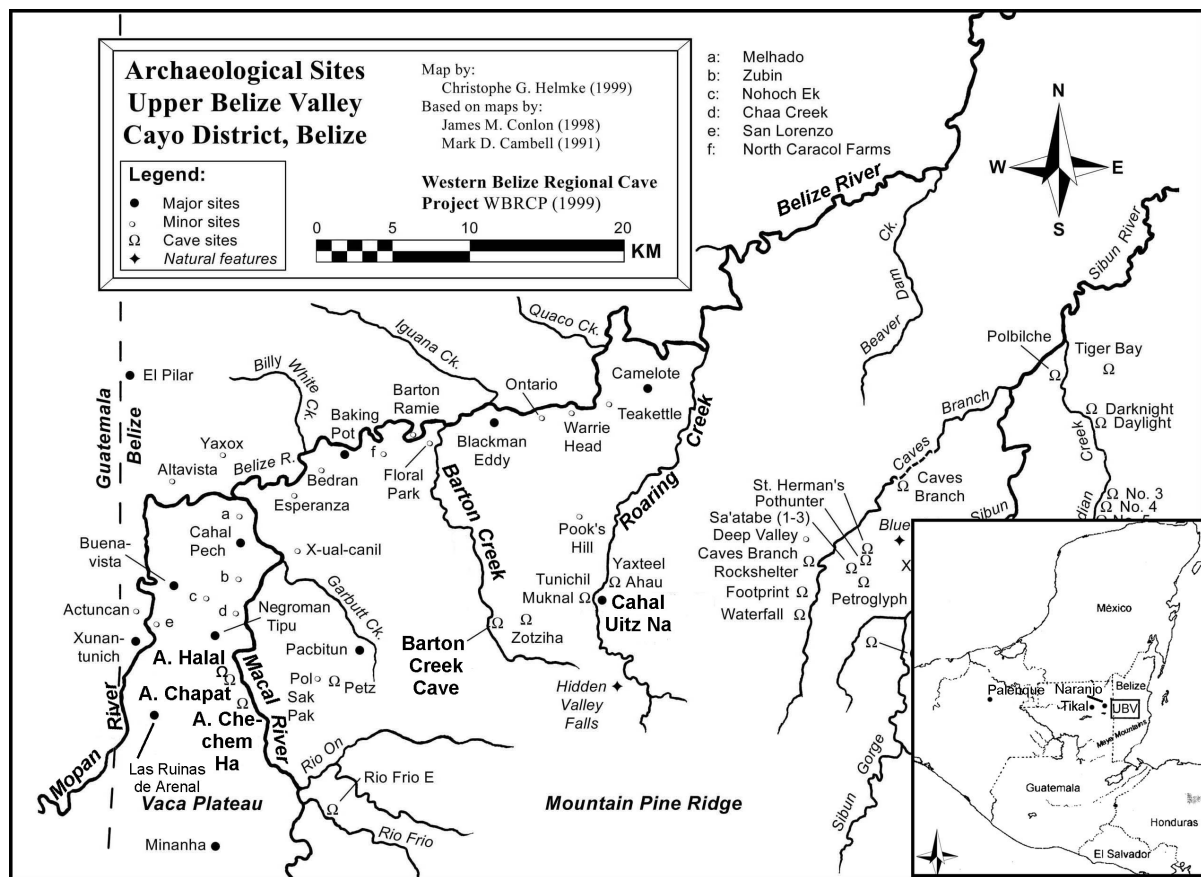


Figure 4.1: Archaeological sites of the Upper Belize Valley (UBV), Cayo District, Belize. Cave sites of this study are in bold (see Figure 4.4 for close-up of Roaring Creek Valley).

Figure 4.2). Research at Cahal Pech has documented even earlier habitation at the end of the Early Formative period (ca. 1200-900 B.C.) (Awe 1992:113). Occupation of the Upper Belize Valley continued throughout the rise and decline of Classic Period Maya civilization and extended into the Post-Classic and Colonial periods at such sites as Tipu (Emery 1999).

By the Middle to Late Formative period (ca. 600 B.C.-A.D. 250) the inhabitants of the Upper Belize Valley displayed signs of social stratification (Awe 1992; Awe and Healy 1996), participated in a long-distance exchange system (Awe and Healy 1994, Healy 1999; Powis et al. 1999), and were exploiting and cultivating a diverse array of plant resources for their subsistence and economic base, including maize, beans, squash, fruit trees, and cotton (Coyston et al. 1999; Lawlor et al. 1995; Powis et al. 1999:369-370; Wiesen and Lentz 1999). Researchers have suggested that this area was a trade link between the Caribbean and regions farther inland to the west (Ford and Fedick 1992:35; McKillop 1980), and evidence for the trade of coastal resources, such as marine shell, occur as early as the Middle Formative period (600-300 B.C.) (Powis et al. 1999:368-369). During the Classic period (A.D. 250-900), the Upper Belize River Valley may have served as a conduit for population movements into the territories of large polities west of the Belize Valley in Petén, Guatemala (Ford and Fedick 1992:35).

Willey et al. (1965:573-576) hypothesized that the majority of prehistoric settlements in the Upper Belize Valley were limited to the alluvial bottomlands, and that upland zones primarily served as agricultural areas, a theory based on the traditional paradigm that the ancient Maya were restricted to swidden, or slash and burn, agriculture. Other research has produced evidence that contradicts that claim. Fedick (1989, 1995), using the individual farming household as the unit of analysis, discovered chronological variations in settlement patterns. Preferential settlement in the fertile alluvial lands was characteristic during periods when regional population levels were lowest (i.e., the Formative period, Terminal Classic period, and Postclassic period) (Fedick 1989:240-245). He did conclude, however, that there is evidence of more continuous house mound habitation as well as higher labor investiture in architecture in the alluvial bottomlands, indicating longer stability and possibly land tenure (Fedick 1989:244). Occupation of the surrounding uplands was denser during the Late Classic period when population levels were highest (Fedick 1989:243-244). In addition, the remains of ancient terrace systems in the uplands strengthen the notion that the Maya were not limited to swidden cultivation but intensively manipulated the natural landscape to support the growing population base (Fedick 1994; Healy et al. 1983; Ower 1927; Thompson 1931:228-229; Turner 1978:168-170; Willey et al. 1965:574-575; Wright et al. 1959:112-113).



| Major Periods                             | Time          | Ceramic Phase |
|-------------------------------------------|---------------|---------------|
| P<br>O<br>L<br>S<br>A<br>T<br>S<br>I<br>C | LATE          | 1400          |
|                                           |               | 1200          |
|                                           | EARLY         | 1100          |
| C<br>L<br>A<br>S<br>S<br>I<br>C           | TERMINAL      | 900           |
|                                           | LATE          | 600           |
|                                           | EARLY         | 300           |
|                                           | PROTO-CLASSIC | 100 A.D.      |
| F<br>O<br>R<br>M<br>A<br>T<br>I<br>V<br>E | LATE          | 100 B.C.      |
|                                           |               | 300           |
|                                           | MIDDLE        | 600           |
|                                           |               | 1000          |
|                                           | Early         | 1800          |
|                                           |               |               |

Figure 4.2: Major time periods of Mesoamerica associated with ceramic phases of the Upper Belize Valley (adapted from Gifford 1976:Figure 8; Cunil dates provided by Awe et al. 1990).

There is no consensus concerning the characterization of the relationships among the sites of the Upper Belize River Valley during the Classic period (Ball and Taschek 1991; Chase 1993; LeCount 1999). Furthermore, there are few syntheses of the culture history of the Belize Valley, and a substantial amount of information has yet to be published. The archaeological record appears to indicate a community of numerous, loosely confederated, autonomous, and economically similar socio-political entities (Taschek and Ball 1999:231). In other words, political structure was decentralized (Ball and Taschek 1991; Fox et al. 1996). Organization and inter-site integration was probably based on kinship alliances (Fox and Cook 1996) and ritualized elite interactions (Demarest 1992) rather than the overt administration and control of economic resources by an overarching political authority (see Chase and Chase [1996], Folan [1992], and Haviland [1992, 1997] for an alternative, centralized perspective that de-emphasizes the ritual- and kinship-

based integration of autonomous centers in favor of the economic control and territorial expansion of a few large polities such as Caracol, Calakmul, and Tikal)

Based on a synchronic regional study, Ball and Taschek (1991) argue that during the Late Classic period (A.D. 650 – 900), the large site of Buena Vista del Cayo was an organizational node among the community of centers in the Upper Belize Valley within the larger polity of Naranjo, a major center located approximately 15-20 km to the east in present-day Petén, Guatemala. There is ample evidence for interaction between Naranjo and the Upper Belize Valley in the form and content of mortuary remains and dedicatory deposits, in the references made in hieroglyphic texts, in ceramic styles, and in architectural forms (Ball and Taschek 1991; Houston et al. 1992; LeCount 1999; Taschek and Ball 1999), indicating significant relationships with the western center. Due to the agricultural productivity of the Upper Belize Valley and its location between trade routes flowing west from the Caribbean and north from the Maya Mountains, the Upper Belize Valley may have been a prime food production zone for dominant western powers such as Naranjo. According to Rathje (1972), Freidel et al. (2002), and McAnany et al. (2002), such a scenario suggests a core-periphery relationship in which goods were traded from peripheral centers, such as those of the Upper Belize Valley, to dominant core centers, such as Naranjo, in exchange for ideological-laden concepts and material culture—a hypothesis borne out by the archaeological evidence of western influence in material culture just discussed.

Although many scholars agree that a decentralized perspective characterizes the social and political organization of Upper Belize Valley and much of the Maya lowlands (Ball and Taschek 1991; Demarest 1992; Fox and Cook 1996; Sanders and Webster 1988), recent research conducted at the site of Xunantunich, located west of the Mopan River, has forced archaeologists to reconsider Ball and Taschek's (1991) claim that Buena Vista del Cayo was the region's primary organizational center for the greater Naranjo state throughout the Classic period (Ashmore and Levanthal 1993, cited in LeCount 1999; Ashmore and Levanthal 2001; Taschek and Ball 1999; LeCount 1999). Ashmore and Levanthal (2001) argue that at approximately A.D. 700, a Naranjo royal family assumed control over Xunantunich and legitimized its political hegemony by displaying connections to the Naranjo state, for example, by copying its architecture. When the political authority of Naranjo began to decline in the mid-ninth century A.D., the Xunantunich ruler asserted regional control by erecting public monuments, such as Stela 8 with the Naranjo emblem glyph, that coincide with the cessation of monument building at Naranjo. Data from Xunantunich indicate that it remained a node of authority for the Upper Belize Valley into the Terminal Classic period (A.D. 790-1000) (LeCount 1999).

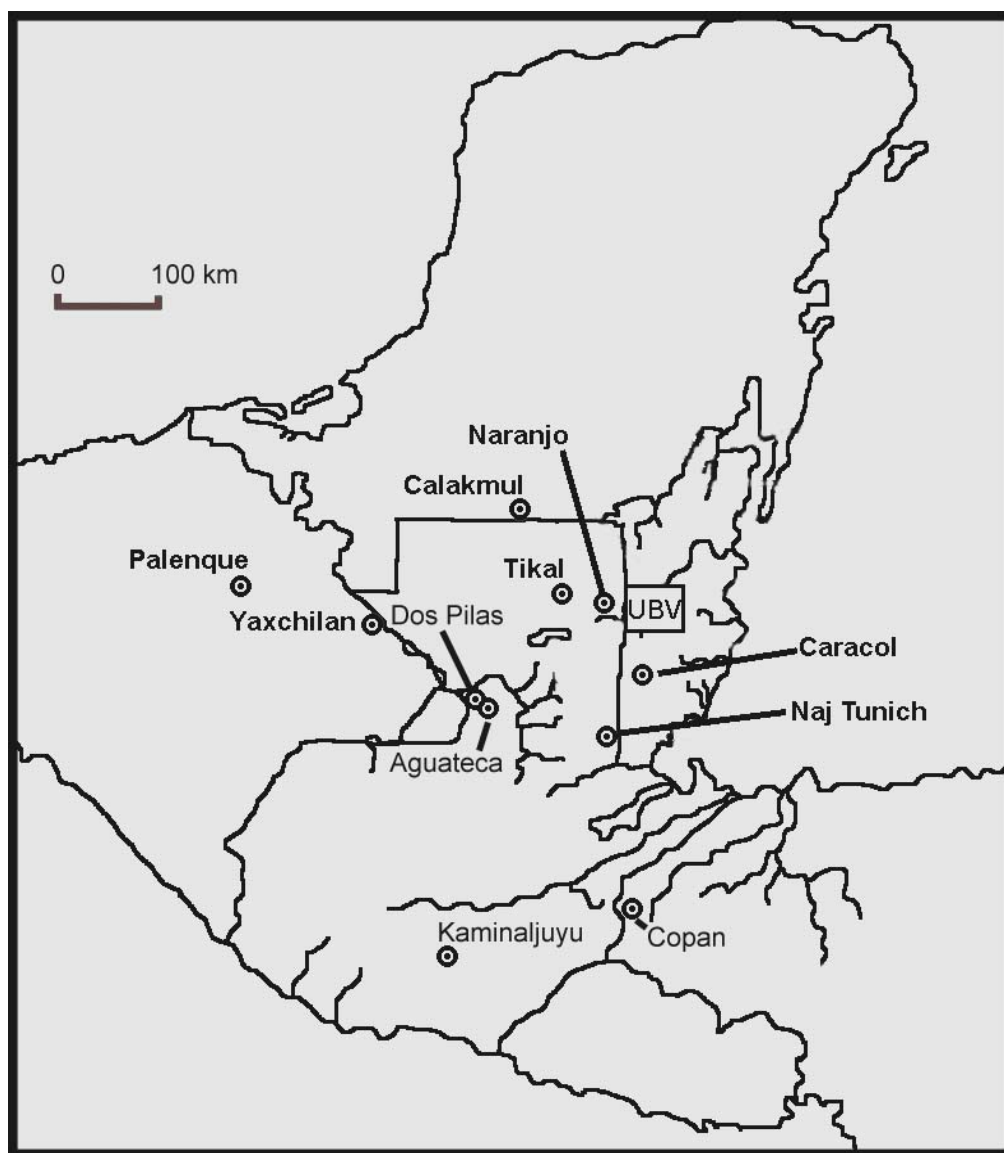


Figure 4.3: Map of Maya region displaying archaeological sites discussed in the text (UBV= Upper Belize Valley).

During the Late to Terminal Classic period, the Upper Belize Valley experienced political instability. Political stress in the Upper Belize Valley is directly related to broader social, political, and environmental processes affecting the entire southern Maya Lowlands during this time (Figure 4.3). There is ample evidence of political competition, such as institutionalized warfare and factionalism, and environmental degradation during the Late to Terminal Classic period in the southern Maya Lowlands.

Indications of political factionalism and militarism, institutionalized warfare (Webster 1993:363), have been found in monuments and architecture erected at many sites during the Late to Terminal Classic period in the southern Maya Lowlands (Demarest et al. 1997; Fash 1991; Fox 1994; Martin and Grube 2000; Miller 1993; Pohl and Pohl 1994). Brumfiel (1994:4) defines factions as “structurally and functionally similar groups which, by virtue of their similarity, compete for resources and positions of power or prestige.” There is evidence for factionalism in western Belize. At Caracol, in the Vaca

Plateau south of the Upper Belize Valley, Late Classic period monuments were erected in order to record the exploits of non-ruling elites. An example is Altar 23, which credits a high-ranking “lieutenant”, *Tum Yohl K’inich*, with the capture of the rulers of Ucanal and B’ital (Martin and Grube 2000:97). The public recognition of non-ruling elites suggests that rulers and conflicting factions were strategically manipulating the social environment during the Late to Terminal Classic period. Perhaps rulers commissioned such monuments to allow for some advancement of the secondary elite in order to calm hostilities and to deter rapidly escalating conflict.

Many centers in the Upper Belize Valley were aligned with larger polities in western Petén, Guatemala, particularly with Naranjo, though their association with such western sites was decentralized. Naranjo and other central Petén sites were characterized by endemic conflict and warfare during the Late Classic period (Martin and Grube 2000:69-83; Schele and Freidel 1990:165-215). In the early Late Classic period (between A.D. 626 to 631),

Naranjo was conquered by an aggressive alliance formed by Calakmul, in northern Petén, Guatemala, and Caracol, in the Vaca Plateau of western Belize (Figure 4.3). Following a brief hiatus, Naranjo experienced a resurgence of power through an alliance with its former conqueror, Calakmul, and Dos Pilas, located to the south in the Petexbatun region of Guatemala. Naranjo's success was short-lived, and, in A.D. 744, the site was attacked by Tikal, a large political center to the west in central Petén. For the remainder of its Late Classic period occupation Naranjo was engaged in conflict with neighboring sites, such as Yaxha, located less than a day's walk to the southwest.

The Upper Belize Valley was in the heart of Late Classic period competitive politics. Despite the region's relationship to western polities, such as Naranjo, centers in the Upper Belize Valley were fully enmeshed in the process of conflict that had developed in the greater southern Maya Lowlands. The paucity of hieroglyphic records in the Upper Belize Valley makes it difficult to determine the degree of warfare and factionalism in the region. On the other hand, archaeological evidence suggests that sites in the Upper Belize Valley were inherently competitive, advantageously asserting their autonomy when the dominance of western sites was under stress from foreign conquest. Besides Xunantunich, which may have been established as a Late Classic political power by elites from Naranjo (Ashmore and Levanthal 2000; LeCount 1999; Martin and Grube 2000:83), other sites in the Upper Belize Valley, such as Cahal Pech, Buena Vista del Cayo, and Las Ruinas del Arenal (Ball and Taschek 1991:162; Taschek and Ball 1999:232) (Figure 4.1), initiated large-scale construction projects when the greater Naranjo polity experienced decline. This process demonstrates their economic and political autonomy, an attribute of decentralized political organization, and indicates that the power void left in the wake of decreased western dominance created heightened political instability, spurring an atmosphere of conflict and competition within and between the numerous centers of the Upper Belize Valley. As the regional powers of the Belize Valley itself, such as Xunantunich, began to collapse, local, non-ruling elites made efforts to establish themselves as politically dominant by building alliances and developing patronages with lesser status groups through feasts and gift-giving (LeCount 1999). These groups also asserted their positions by conducting rituals in the many caves in the valley (Halperin 2002; Helmke 1999). Their objective was probably to identify themselves with features of mythology and cosmology to heighten their political authority (see below).

Environmental stress was a substantial contributing factor to the political instability experienced in the southern Maya Lowlands during the Late to Terminal Classic period. Environmental conditions do not necessarily determine the course of political processes, but their influence on political relationships can be substantial. Environmental degradation jeopardized the resource base that sustained populations, including agricultural

productivity, available woods for construction and fuel, the diversity of game animals, and many others. Although the degree to which Maya elites and rulers controlled economic subsistence resources is unclear, they probably demanded tax and tribute from their constituent client populations, and larger, more dominant centers demanded tribute from smaller, less powerful sites at different times. Elite groups fuel their political authority by harnessing resources into surpluses that can be used in prestige-enhancing ways (Brumfiel 1994:6; Hayden and Gargett 1990; Sahlins 1968:89), such as feasts. As their power grows, the need for more surpluses builds proportionately in order to maintain their hegemonic status. With increased environmental stress, the resources that were harnessed by ancient Maya elites became "vulnerable to overexploitation" (Hayden and Gargett 1990:5). This process heightened social and political instability as rulers continued to exact tribute while becoming less capable of providing benefits to the populace, a fundamental aspect of patron-client relationships (Pohl and Pohl 1994:140). These events created a fertile environment for the growth of competing factions that were able to attract followers from dominant political groups.

Although there have been no systematic paleoecological studies in the Upper Belize Valley, comparative paleoecological data from elsewhere in the Maya Lowlands indicate that the Late to Terminal Classic period was marked by widespread natural and human-induced environmental degradation (Abrams and Rue 1988; Abrams et al. 1996; Curtis et al. 1996; Hodell et al. 1995; Islebe et al. 1996; Leyden 1987; Paine and Freter 1996; Rice 1978; Tsukada 1966; Wiseman 1978). Climatic reconstructions suggest that a drought occurred during this time. An increase in oxygen isotopes in shell carbonate and an increase in gypsum in sediments from lake cores located in north and central Yucatan, Mexico, indicate a peak period of aridity between A.D. 800 and A.D. 1000 (Curtis et al. 1996; Hodell et al. 1995). This dry period is also recorded in other Mesoamerican and Central American paleoclimatic records, evidence that drought was not a local phenomenon (Curtis et al. 1996).

Palynological and soil studies conducted at sites in the southern Maya Lowlands have documented human-induced environmental degradation, such as deforestation and erosion (see Chapter 2). Much of this work has emphasized a Malthusian perspective, stressing the deleterious impact of population pressure on local ecological conditions. Research in the Copán Valley, Honduras, produced evidence that as the population grew in the Late Classic period, agricultural practices expanded and intensified (Abrams and Rue 1988; Abrams et al. 1996; Paine and Freter 1996). The need for agricultural land coupled with growing wood consumption for fuel and construction led to extensive deforestation, resulting in severe rates of erosion and drastic decreases in soil fertility.

In central Petén, Guatemala, the palynological record suggests a process of deforestation similar to that of the Copán Valley (Islebe et al. 1996; Leyden 1987; Rice 1978; Tsukada 1966; Wiseman 1978). During the Late Classic period, when the region's prehistoric population was highest, pollen records display a climax of environmental disturbance, indicated by high charcoal levels and pollen from domesticated taxa (i.e., maize) and weedy flora associated with agricultural activities. Pollen data after the Late Classic period contain substantially lower levels of domesticated taxa and disturbance indicators and higher levels of arboreal forest species, suggesting a rapid reduction in agricultural practices in the region during this time.

The Upper Belize Valley was not isolated from the environmental degradation affecting the greater Maya Lowlands. Despite the lack of paleoecological data from the area, there are indirect archaeological indications that the region suffered from ecological stress. The majority of available land-space during the Late Classic period was being used for settlements, "kitchen" gardens, infield cultivation, and outfield agriculture in the alluvial floodplains and terraced foothills (Ball and Kelsay 1992; Fedick 1989, 1994, 1995), probably leading to a pattern of deforestation comparable to other sites such as Copán. As populations grew in the Upper Belize Valley during the Late Classic period, maize agriculture increased. Analyses of stable carbon and nitrogen isotopes of human bone collagen from burials at Pacbitun, located west of the Macal River, reveal that the consumption of maize or maize-fed animals was highest during this time (Coyston et al. 1999; White et al. 1993). Settlements and agricultural practices expanded beyond the alluvial floodplains to the surrounding foothills (Fedick 1989, 1995), and Late Classic period Maya farmers constructed terraces in these upland zones, probably to prevent erosion from intensive cultivation (Chase and Chase 1998; Fedick 1994; Healy 1983; Healy et al. 1983; Neff 1997). Organic-rich soil phosphate levels in settlement mound clusters surrounding larger centers, such as Guerra, a plazuela-focused cluster located less than a kilometer south of Buena Vista del Cayo, suggests that the Maya also maintained house-lot "kitchen" gardens or interstitial infields during the Late Classic period (Ball and Kelsay 1992).

By the Terminal Classic period, Maya farmers were no longer able to maintain earlier levels of maize consumption. Intensive agriculture and terrace construction continued during the Terminal Classic period, but isotopic data document a decrease in maize consumption (Coyston et al. 1990; White et al. 1993). This situation may have been the result of decreased soil fertility due to continued short-fallow agriculture and erosion, lower productivity and crop failure from drought, overwhelming population subsistence requirements combined with increased tribute demands, or all of the above. The reduction in maize consumption at sites like Pacbitun was followed by the abandonment of many of

the Upper Belize Valley's major political centers, demonstrating that ecological and political processes were mutually influential factors.

### **Cave Rituals and Instability in the Upper Belize Valley**

This section will address the possible role of caves in social and political processes in the Maya Lowlands during the Late Classic period. These broad patterns in cave utilization are applicable to the use of caves by the ancient Maya of the Upper Belize Valley. As discussed above, the Upper Belize Valley was marked by the political upheaval and natural and human-induced environmental degradation that affected the entire southern Maya Lowlands during the Late Classic period. During this time, the utilization of the majority of the caves in the region, and all of the caves presently under investigation (see below), intensified. This increase in cave rituals can be explained in light of broader social, political, and ecological conditions.

A dramatic increase in ritual offerings during the Late Classic period may indicate ritual efforts to combat broader environmental stress. The evidence for drought, deforestation, and decreased consumption of maize-based food items despite continued efforts at intensive agriculture is widespread in the southern Maya Lowlands during the Late Classic to Terminal Classic periods. As discussed in the previous chapter, the association between caves and earth deities is one of the dominant themes surrounding ancient Maya perceptions of caves. An earth deity may be broadly defined as any god who controls nature, especially those natural elements that are of immediate concern to the Maya for essential economic activities. Earth deities include rain deities or *chacs*, gods that own the products of the earth, such as the modern Tzotzil Maya Earth Lord (Vogt 1976:16-17), and the maize god, who was resurrected onto the earth through a cave. The ancient Maya probably reacted to ecological stress by increasing ceremonial offerings to such earth deities believed to reside in caves in order to petition for rain and agricultural productivity. Despite these attempts, the Maya were unsuccessful; environmental instability and decreased agricultural yields continued, contributing to the eventual abandonment of most of the Upper Belize Valley's major Late Classic period centers and settlements.

Although rituals focused toward earth deities for agricultural purposes likely increased during the Late Classic period, the utilization of caves also served political goals during this time. Furthermore, due to the high level of social, political, and ideological integration in indigenous societies (Keesing 1982), including the ancient Maya, it is not easy, and may be misleading, to extract agriculturally focused rituals from broader social and political dimensions. The political climate during the Late Classic period in the Upper Belize Valley, like that of the greater southern Maya Lowlands, was characterized by conflict and competition. Ritual

activities were a substantial means by which centers, rulers, and factions competed with one another and asserted their dominance. The increased utilization of caves suggests that ancient Maya political aggrandizers were ritually appropriating salient symbols of the cosmological system in order to establish an ideology that legitimized their social, economic, and political power

Before presenting examples of how the Maya utilized caves in political processes, it is first necessary to explore theoretical perspectives of ritual and ideology that justify this approach. Ideologies are societies' ideas of the world, especially as they involve social relationships. They have the potential to become established as a society's world-view, or the concept of the order of existence (Geertz 1973:127). Ideologies often remain unquestioned because they present and reinforce the way things are; they are integral to the construction and maintenance of a group's cultural models of reality (Quinn and Holland 1987:13). They can become embedded in a people's habitus (Bourdieu 1977:72), the habituated and internalized knowledge of the processes of social discourse that influences social action. Thus, ideologies are part and parcel of the lenses through which people perceive and understand the world and their places within the world.

The theoretical perspective of ideology applied in this thesis emphasizes its political role in maintaining and replicating asymmetrical social relationships in the structure of societies (see Giddens 1979). Ideological systems are strategically mobilized to institute domination or resistance and to legitimize the sectional interests of dominant or competing groups (Earle 1997:143; Giddens 1979:188; Kertzer 1988). Geertz (1973:201) refers to this view of ideology as interest theory, in which ideological processes are evaluated in terms of a "universal struggle for advantage." Thus, ideologies are social capital (Bourdieu 1977:171) that can be exploited to obtain economic and political capital. This process is recursive. As political and economic authority grows, there is increased need for ideological control in order to maintain political and economic power.

Politically aspirant groups promulgate ideologies that support asymmetrical social relations and nourish views of the political order through the ritual manipulation of symbolic systems. Ritual is a "symbolic mode of communication" (Firth 1973:176) because symbols are the basic units of ritual activity. Cultures depend on the collective enterprise of ritual to establish the externalized reality of ideological beliefs, values, and perceptions, including the acceptance of social inequalities (Kertzer 1988:85). This process has been referred to as the materialization of ideology, or the transformation of ideological systems into a physical reality (DeMarrais et al. 1996; Earle 1997:151-158). By ritually appropriating and manipulating socially salient symbols toward political ends, powerful groups not only assert their dominance as an aspect of reality but also reproduce the

social inequalities already inherent in the structure of society (Giddens 1979).

The utilization of ritual in order to establish ideologically justified social inequalities is not a static relationship between rulers and ruled. Rather, groups competing for hegemonic status, factions, actively manipulate ritual toward their own benefit. Ritual provides a means by which subordinate groups can initiate resistance and revolt (Kertzer 1988:168). Factional conflict often increases during times of environmental stress (Anderson 1994), especially when economic resources that are asymmetrically harnessed by dominant groups are over-exploited (Hayden and Gargett 1990:5), a condition likely experienced by the inhabitants of the Upper Belize Valley. Differential access to economic requirements during times of stress threatens to oppress subordinate groups economically and provides a window of opportunity for groups seeking to take over or redefine the political order.

Caves were effective symbolic capital (c.f. Bourdieu 1977:171-183) of Maya ideology that was ritually harnessed by groups pursuing social, economic, and political power. By associating themselves and their acts with caves, such groups identified themselves as sacred (Brady 1989:60) and, as a result, legitimized their social, economic, and political hegemony. Researchers have explored a number of ways in which caves were utilized in Maya political negotiation. These perspectives focus either on the organization of ceremonial centers in direct association with caves or on rituals conducted in caves or in relation to cave symbolism.

One of the most archaeologically prominent methods that rulers utilized to associate themselves with the cosmological significance of caves was through site-planning. Maya rulers commissioned the construction of massive temples and palaces that utilized a substantial quantity of labor and energy from the population (Abrams 1994). The manipulated and socially constructed geography influences how individuals perceive of the landscape by physically portraying social messages that demonstrate control and power over a society (Ashmore 1989:273; Earle 1997:155-158). Organizing monumental construction efforts toward features of the sacred landscape strengthens this process. By constructing monumental architecture in relation to caves, Maya rulers legitimated their domination by associating themselves and their acts with cosmological themes.

Recent research has uncovered numerous examples of how the ancient Maya organized the construction of temples and entire sites in geographical association with caves. Brady (1997; Brady et al. 1997) concluded that the construction of Dos Pilas, Guatemala, was closely associated with the caves under the site. The primary temple at Dos Pilas, El Duende Pyramid, was constructed directly over a cave, Cueva del Rio El Duende. Other structures at Dos Pilas were also built in relation to caves.

The discovery of artificial caves underlying monumental constructions emphasizes how the landscape was actively manipulated in conformity with ideological systems. In the highlands of Guatemala, Brady and Veni (1992) discovered numerous artificial caves in direct association with a number of ceremonial centers: Mixco Viejo, Esquipulas, La Lagunita, and Utatlan. Brady and Ashmore (1999:136) suggest that the cave beneath the central plaza at Utatlan represents the cave of origin in Quiché myth. The location of the site upon this artificial cave is thought to have sanctified Utatlan and legitimized the authority of Utatlan's ruling groups.

Farther from the Maya region, Hayden (1975, 1981) has interpreted the cave under the Pyramid of the Sun at Teotihuacan, Mexico, as the center of the Teotihuacan universe, or *axis mundi*. The *axis mundi* was the source of deities and cosmological potency for Mesoamerican societies. The construction of monumental architecture in relation to the cave served to legitimize Teotihuacan as an economically and politically powerful center that attracted groups throughout Mesoamerica (Millon 1967). Further, the Teotihuacan evidence reveals that structuring settlements in relation to caves was widely practiced in Mesoamerica.

Rituals conducted in caves or in relation to cave symbolism were another means by which ideological processes were mobilized in favor of groups aspiring for power. Pohl (1981, 1983) and Pohl and Pohl (1983) have identified iconographic imagery within elements of Maya material culture as indicative of ancient Maya *cuch* ceremonies. The *cuch* ceremony is an ancient version of modern day cargo rituals that involved the ritual sacrifice of white-tailed deer stags. Cargo rites are annual ceremonies that involve the transference of political office from one individual to another. Performing *cuch* ceremonies in caves symbolically linked rulers to natural cycles of Maya cosmology, agricultural fertility, and economic success and, thus, sanctified and legitimized their rule. Faunal assemblages recovered from caves and cenotes suggests that these areas were loci for *cuch* ceremonies (Pohl 1983; Pohl and Pohl 1983). Iconographic representations of period-ending ceremonies are often associated with caves, suggesting that caves were loci for such rites (Bassie-Sweet 1991, 1996; Stone 1989).

This is not a new interpretation, however. Pohl (1983:70) states, "in ancient times the Maya may have performed a ceremony similar to the *cuch* rite not only each year but also at significant period endings and at the inauguration of rulers." When the *katun* period ended in the Maya calendar, the forces of the universe threatened to destroy the earth (Bassie-Sweet 1996:140). Maya rulers were responsible for conducting proper rituals during these times in order to maintain the structure of life and the continuation of time. The Maya held a quadrilateral model of the universe with northern, southern, eastern, and western horizons bounding the center (Thompson 1970:196). According to Bassie-Sweet (1996:140-145),

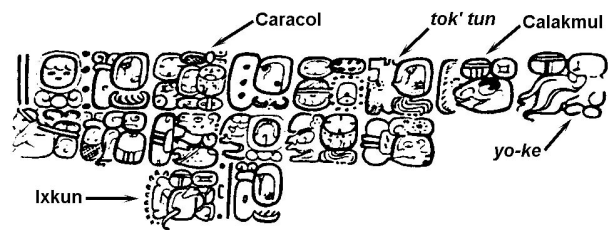


Figure 4.4: Drawing 82 from Naj Tunich Guatemala displaying emblem glyphs from prominent sites mentioned in the cave's texts (redrawn from Stone 1995:Figure 7.29).

the midpoints of the four horizons were centered on caves. She argues that these midpoint caves were the loci for rites during *katun* endings. Iconography found in caves supports this observation. Stone (1989:330-334) has interpreted pictographs from caves in the Maya area, such as Jolonié or Joljá, Mexico, Dzibah Actun, Mexico, and Naj Tunich, Guatemala, as graphic evidence that *katun* ceremonies were undertaken in caves. Due to the liminality of caves and rites of passage, it is probable that caves were the location for ceremonies that marked the transition from one period of time to another.

Archaeological evidence suggests that caves were stages for ritual activity by groups, factions, or polities competing for social, political, and ideological dominance. Helmke (1999; Helmke et al. 1998) has suggested that Belize Valley specimens of molded-carved vases (Caves Branch variety), diagnostic of the Terminal Classic period (ca. A.D. 900-1000), may serve as indicators of a secondary elite. These vessels are found at large, peripheral residences at surface sites, such as Altun Ha and Baking Pot, Belize, as well as in numerous caves in the Upper Belize Valley and the Sibun River Valley (Helmke 1999; Helmke et al. 1998:101). Although the iconography of the vessels suggests that the owners held a high status, the absence of any ruling titles within the main glyph band indicates that these individuals were not members of the ruling elite. Further, there are two additional glyphs in the nominal section that translate to *olom u k'auhal*, "lineage the proud," suggesting a competitive social atmosphere between non-ruling and ruling elite groups (Helmke 1999:8). Helmke (1999:10) proposes that "laws" had restricted the performance of cave ceremonies to the ruling elite. During the fragmented social order of the Terminal Classic period the presence of molded-carved vessels in caves may be indicative of a struggle for political power through the manipulation of ritual activity.

The hieroglyphic texts at Naj Tunich, Guatemala, southwest of the Upper Belize Valley, indicate that this cave played a role in the competitive politics in this region of the southern Maya Lowlands (Figure 4.5). Texts at Naj Tunich demonstrate that participants in political processes, such as nobles, rulers, or other ritual specialists, from a number of polities visited the cave (Figure 4.4) (Stone 1995). Emblem glyphs from Caracol, Calakmul, Ixkun, possibly Sacul, as well as the





Figure 4.5: The Roaring Creek Valley, facing south over the alluvial flood plain toward the the Maya Mountains

unidentified polities of *tok' tun* and *yo-ke* are present in Naj Tunich hieroglyphic texts (Colas 1998; Stone 1995:179-183). The numerous polities in Naj Tunich texts suggest that the site may have functioned in establishing inter-polity alliances through ritual (Stone 1995:183). Conversely, Colas (1998) has argued that the texts document an invasion of Caracol by Ixkun during the mid-eighth century A.D., a time when Caracol's regional dominance was in decline. The Caracol "ruler" discussed in the text at Naj Tunich is *Tum Yohl K'inich*. The actual political status of *Tum Yohl K'inich* is unclear, and his appearance on monuments at Caracol suggests that he was a "lieutenant" or living relative of Caracol's king rather than a ruler himself (Figure 4.4) (Martin and Grube 2000:97). The appearance of *Tum Yohl K'inich* in Naj Tunich texts emphasizes the significance of non-ruling political players, perhaps members of competitive factions, in the regional political climate of the southern Maya Lowlands.

### The Environmental and Cultural Setting of the Cave Sites

#### Roaring Creek Valley

The Roaring Creek is one of the primary waterways for the Upper Belize Valley watershed (Smith 1996) (Figure 4.5). Tectonic uplift of the Maya Mountains and fluvial erosion continue to contribute to the formation of Roaring Creek Valley. The river flows north from the Mountain Pine Ridge to the Belize River. The valley is oriented east-west, parallel to the course of the Northern Boundary Fault. The geological history of the region has produced a karst, limestone geomorphology containing numerous subterranean caves and conduits.

The vegetation of Roaring Creek Valley consists of subtropical and tropical moist forests composed of deciduous, broadleaf forest (Smith 1996). Tropical moist

forests receive between 2,000 and 2,700 mm of annual rainfall, and subtropical moist forest receive only 1,300 to 2,000 mm of rain annually. Trees commonly found in this area include mahogany (*Swietenia macrophylla*), cedro (*Cedrela mexicana*), ramón (*Brosimum alicastrum*), gumbo limbo (*Bursera simaruba*), give and take (*Crysophila argentea*), cohune palm (*Attalea cohune*), fig (*Ficus* sp.), copal (*Protium* sp.), botan palm (*Sabal mauritiformis*), chicle (*Manilkara* sp.), cojoton (*Stemmadenia donnell-smithii*), cacao (*Theobroma cacao*) and a wide diversity of others. The upper Roaring Creek is also in close proximity to pine (*Pinus oocarpa*) forests that extend north from the Mountain Pine Ridge. This area is also the habitat for numerous mammal species, including tapir (*Tapiris bairdii*), coatimundi (*Nasua narica*), black howler monkey (*Alouatta pigra*), paca (*Agouti paca*), peccary (*Tayassu* sp.), white-tailed deer (*Odocoileus virginianus*), jaguar (*Panthera onca*), ocelot (*Felis pardalis*), and many others (Smith 1996).

Relatively little was known about the archaeological significance of the Roaring Creek River Valley until the Western Belize Regional Cave Project undertook cave and settlement reconnaissance in the area. Since 1996, the project has recorded numerous habitation sites, caves, and rockshelters that were intensively utilized by the ancient Maya (Awe et al. 1998) (Figure 4.6). The rich, alluvial soil of Roaring Creek's floodplain terraces were well-suited for supporting the region's population, a pattern observed at other sites in the Belize Valley (Willey et al. 1965).

The largest site discovered in Roaring Creek Valley is the medium-sized center Cahal Uitz Na, located on the east bank of the upper Roaring Creek (Figure 4.7). Cahal Uitz Na's core is similar in size to other small Belize Valley centers, such as Cahal Pech, Pacbitun (Awe and Helmke 1998), and Las Ruinas de Arenal (Taschek and Ball 1999). The site has been characterized as a secondary or

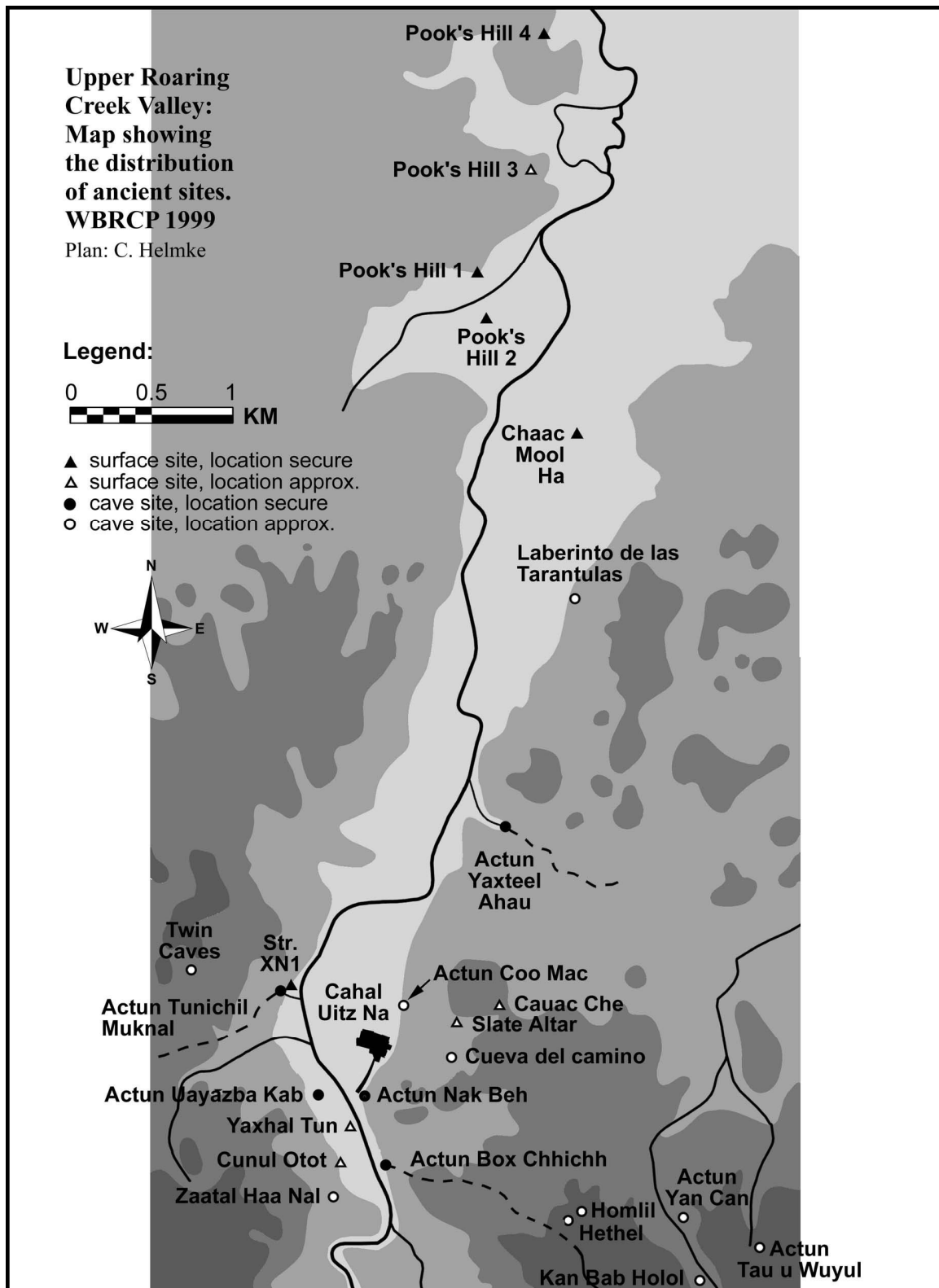


Figure 4.6: Map of the Roaring Creek Valley showing surface sites and cave sites recorded by the Western Belize Regional Cave Project (Map by Christophe Helmke).

“provincial” center (Halperin 2002:35). The site core consists of a number of plazas, pyramidal structures, range-type structures, residential structures, slate monuments and stelae, and a ball court. A causeway runs south from Plaza A and terminates at the entrance of the cave Actun Nak Beh, one of the cave sites in this study (see below). Test excavations conducted at Cahal Uitz Na

indicate that the site was occupied as early as the Early Classic period (A.D. 300-600) (Ehret and Conlon 1999), but occupation and construction were more intense during the Late Classic period (A.D. 700-900) (Awe and Helmke 1998:213). Although the majority of investigations carried out at Cahal Uitz Na are preliminary, current evidence indicates that it was the dominant organizational



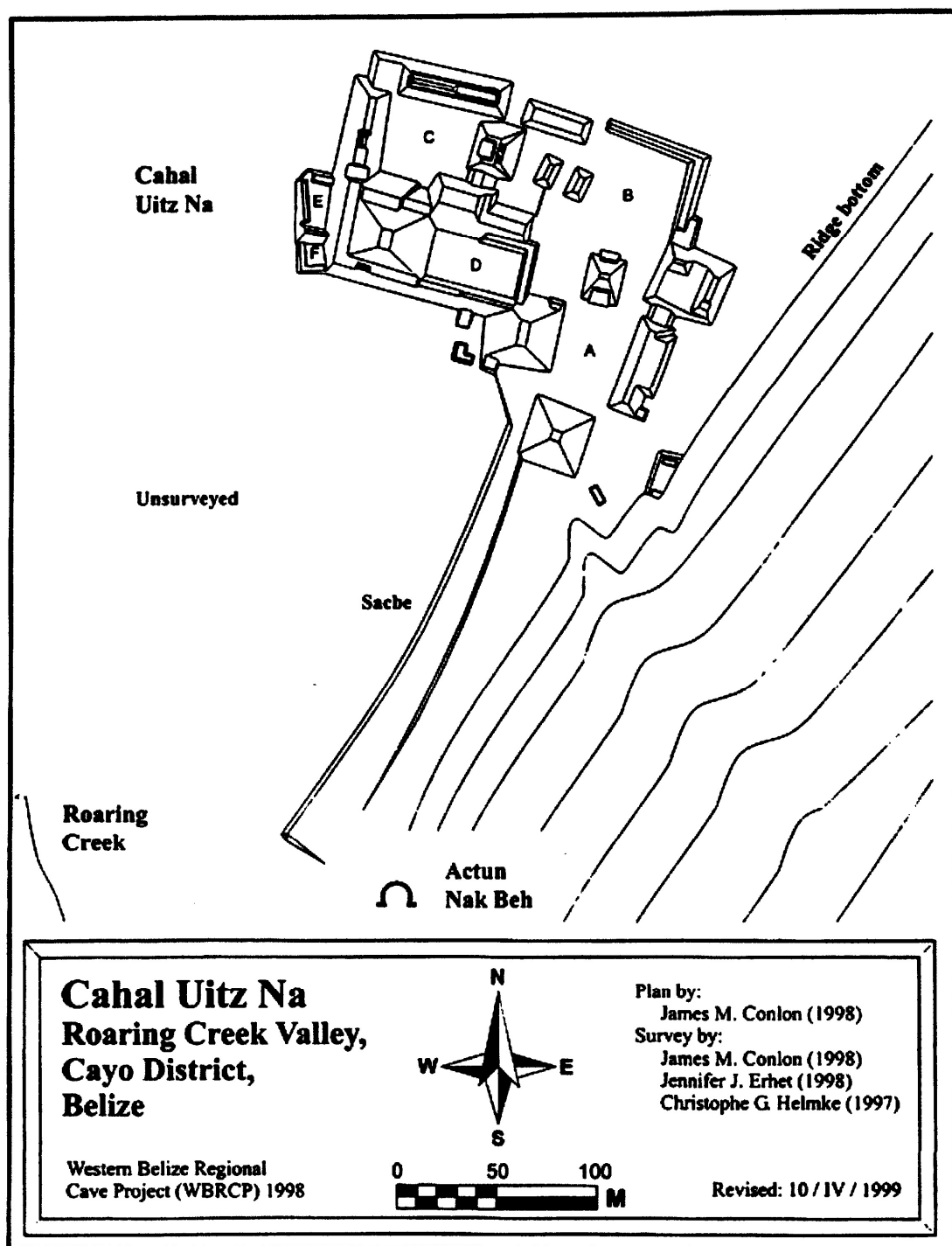


Figure 4.8: Plan map of Cahal Uitz Na, Cayo District, Belize.

center for the Late Classic population of the Roaring Creek River Valley (Awe and Helmke 1998).

Many caves exist near Cahal Uitz Na and throughout Roaring Creek Valley (Awe 1998; Awe and Helmke 1998). Three cave sites were subjected to archaeobotanical investigation: Actun Nak Beh, Twin Caves 2, and Laberinto de las Tarantulas, or Tarantula

Cave. The scale of archaeobotanical sampling differed among the three sites. At Actun Nak Beh, sampling for botanical remains was undertaken in conjunction with excavations. Archaeobotanical sampling at Twin Caves 2 and Tarantula Cave was the result of brief reconnaissance and, thus, was minimal

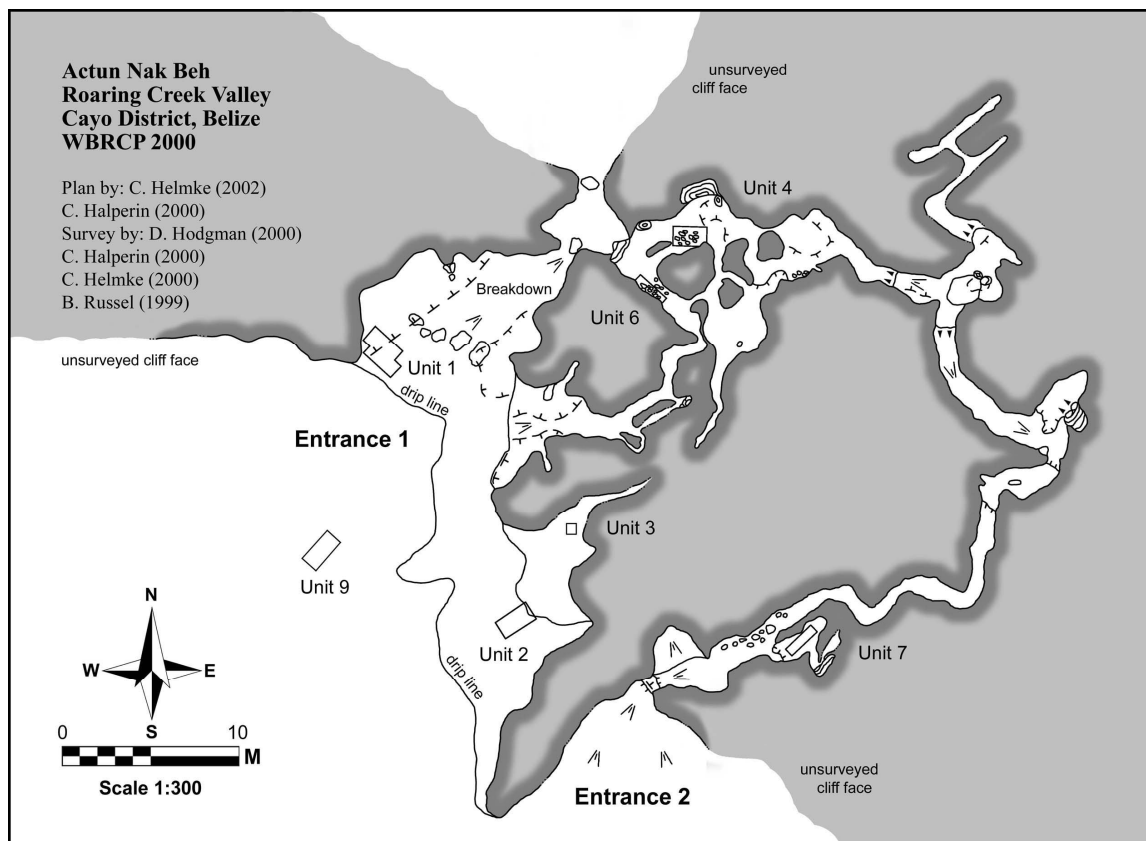


Figure 4.8: Plan map of Actun Nak Beh, Cayo District, Belize.

**Actun Nak Beh.** Actun Nak Beh was first discovered by the Western Belize Regional Cave Project in 1996 (Awe and Helmke 1998) (Figure 4.8). Actun Nak Beh is located 150 m east of Roaring Creek. Actun Nak Beh is a small, dry cave with two entrances. The primary entrance, Entrance 1, is a 5 to 7 m overhang at the base of a cliff, morphologically similar to a rockshelter (Halperin 2002:38). Entrance 2 is substantially smaller, approximately 1 m in diameter, and is located about 20 m south of Entrance 1. The cave's interior consists of a long, narrow, U-shaped passage that connects the two entrances. Five small chambers are located in different areas throughout the central passageway.

Archaeological investigation of Actun Nak Beh continued with varying degrees of intensity from its discovery in 1996 to 2000. During the 2000 field season, archaeologists conducted test pit excavations at the site (Halperin et al. 2001; Halperin 2002). Archaeological remains include secondary burials, groundstone artifacts, polychrome and molded-carved ceramics, jade, and obsidian perforators. According to ceramic data, the interior of Actun Nak Beh was used predominantly during the Early Classic period (Hermitage Phase) (ca. A.D. 300-600), while the exterior was used primarily during the Late Classic period to Terminal Classic period (Spanish Lookout Phase) (ca. A.D. 700-900). Archaeobotanical sampling was conducted in conjunction with excavations.

The most notable archaeological feature at Actun Nak Beh is a 240 m long causeway that extends from Actun Nak Beh's Entrance 1 to the southwest corner of Plaza A at Cahal Uitz Na. The direct association of the ceremonial center with the cave indicates that Actun Nak Beh was a cosmologically salient geographical feature for the occupants of Cahal Uitz Na. Specifically, Halperin (2002:119-122) has proposed that Actun Nak Beh was a local pilgrimage center that may have attracted ceremonial practitioners from throughout Roaring Creek Valley. Halperin (2002:125) has argued that the unrestricted nature of Cahal Uitz Na's Plaza A, the causeway, and the main entrance of Actun Nak Beh indicate that this "open" space was used for public rituals. Public rituals would allow both the creation of social cohesion and the establishment of political and economic hierarchies. The association of Cahal Uitz Na with Actun Nak Beh, in close proximity to many other caves, communicates that high status groups, those who commissioned the site's construction, were in control of the sacred space. Control over the cave sites and rituals conducted in them sanctified the social, economic, and political dominance of the rulers of Cahal Uitz Na.

**Twin Caves 2.** The Western Belize Regional Cave Project discovered Twin Cave 2 (Figure 4.9) and its sister cave, Twin Cave 1, in 1997 (Awe et al. 1998). Twin Cave 2 is located west of Roaring Creek, approximately 1 km northwest of Cahal Uitz Na. The cave is dry with numerous stalactites on its ceiling. Its entrance is wide and narrow, approximately 3 to 3.5 m high and 15 m

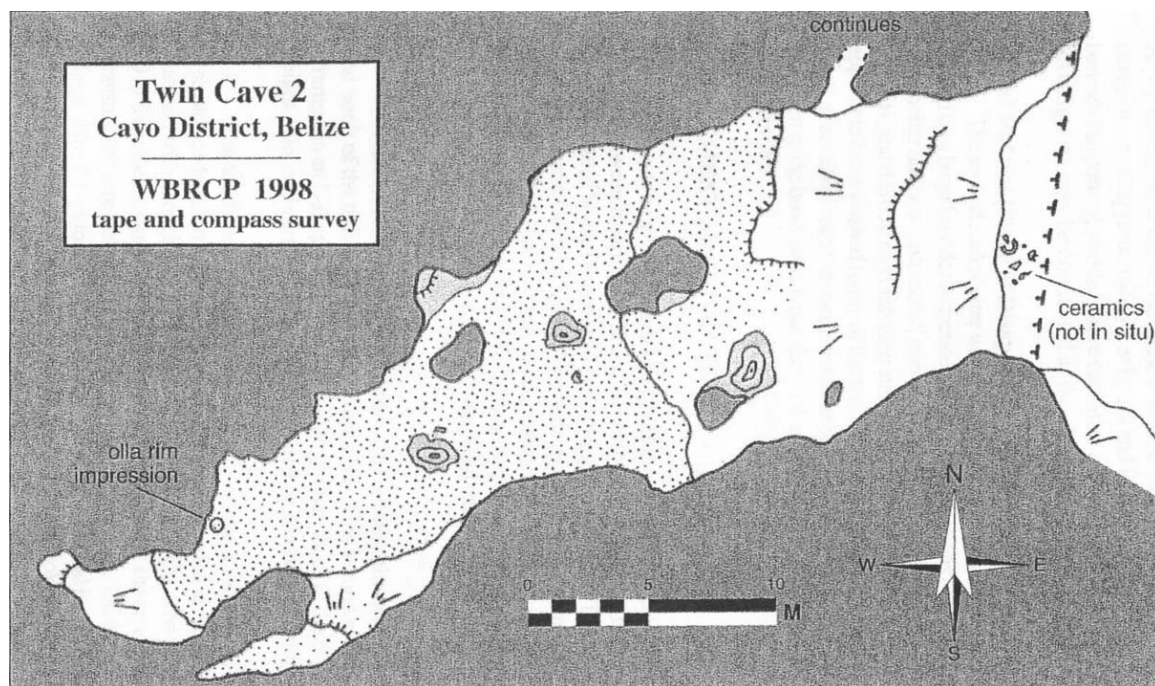


Figure 4.9: Plan map of Twin Caves 2, Cayo District, Belize (adapted from Awe et al. 1998).

wide. The interior slopes down from the entrance until the cave floor levels off inside. The high position of the entrance in relation to the cave's central chamber keeps most of the cave in the penumbral, or twilight, zone. Archaeological research at Twin Caves 2 has not been extensive. In 1997, researchers mapped most of the cave and recorded observations of the cave's artifactual assemblage (Awe et al. 1998:227). Ceramic sherds from many pottery forms were found on the cave's floor and ledges, including wide-mouthed ollas, basal flange dishes with ring bases, and bowls. In 2000, researchers returned to Twin Caves 2 for further reconnaissance. Flotation samples were collected from a hearth feature located in an alcove at the western end of the cave. The hearth feature was in a good state of preservation, and it was associated with ceramics attributable to the Tiger Run Phase, or the early part of the Late Classic period (ca. A.D. 600-700).

**Tarantula Cave.** The Western Belize Regional Cave Project discovered *Laberinto de las Tarantulas*, or Tarantula Cave, in 1996 (Awe et al. 1998; Helmke et al. 1999; Ishihara and Helmke 2002) (Figure 4.10 and 4.11). The cave is located approximately 1 km east of the Roaring Creek and 3.5 km northeast of Cahal Uitz Na. Tarantula Cave was formed by the collapse of a chambered waterway that drains from the Mountain Pine Ridge. The cave is marked by numerous, small, interconnected passages created by spaces in the collapsed breakdown.

Archaeological study of Tarantula Cave has continued since its discovery. Investigations have focused primarily on reconnaissance, mapping, and the documentation of artifacts. At the time of discovery, archaeologists noted that the cave had undergone extensive looting and that looting activities were continuing between archaeological

field seasons (Helmke et al. 1999). Nevertheless, abundant archaeological remains, such as ceramics, architectural features, and a slate monument or "stela," were documented. According to ceramic data recovered from Tarantula Cave, the site experienced a peak of utilization during the Terminal Classic period (c.a. A.D. 800-900) (Helmke et al. 1999; Ishihara and Helmke 2002), evidence that suggests the cave played a significant role in the social and political dynamics in Roaring Creek Valley at the end of the Classic period (Ishihara and Helmke 2002).

During the 2000 field season, researchers encountered a concentration of artifacts and human remains (Cluster 67) on the surface of one of the cave's lower passages (Passage 9). This area was sampled for archaeobotanical and small archaeological remains. Five flotation samples were collected at a depth of up to 15 cm (Cameron Griffith, personal communication 2000). The light fractions from these samples constitute Tarantula Cave's archaeobotanical assemblage discussed in the next chapter.

### **Barton Creek Valley**

Barton Creek Valley is similar to Roaring Creek Valley in terms of vegetation and geomorphology. Like Roaring Creek, Barton Creek is one of the principal rivers of the Upper Belize River watershed (Smith 1996) (Figure 4.1). The river drains waters flowing north from the Mountain Pine Ridge. The vegetational characteristics are the same as Roaring Creek, although part of the area has been deforested due to agriculture and pasturing. The area is composed primarily of deciduous moist forests. Upper Barton Creek is also in close proximity to stands of pine forest.

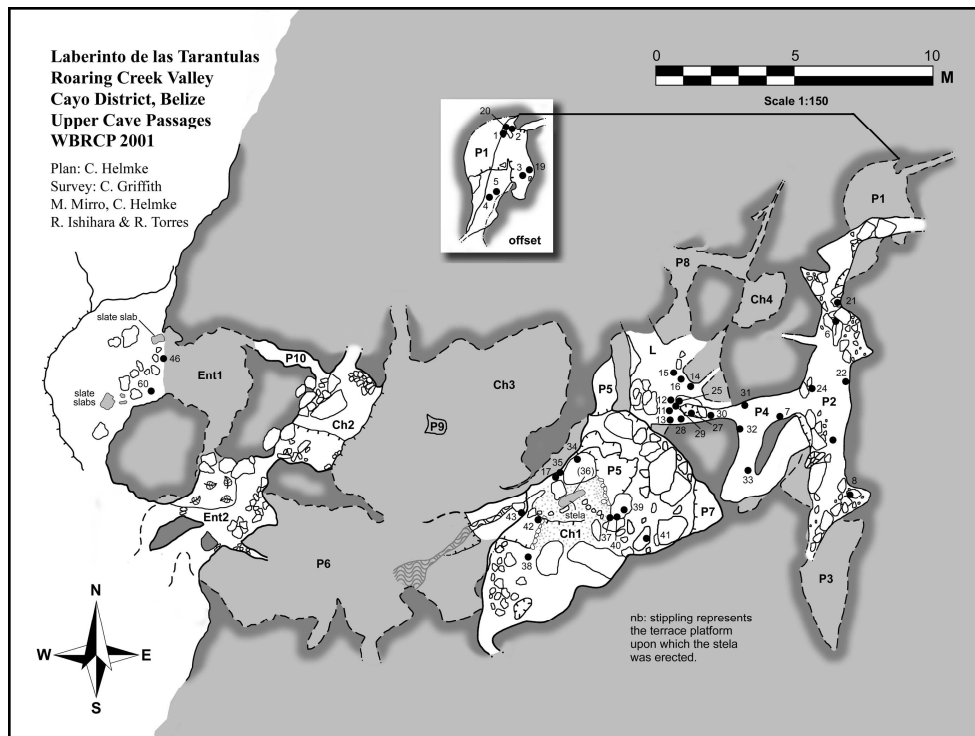


Figure 4.10: Upper cave passages at Tarantula Cave, Cayo District, Belize.

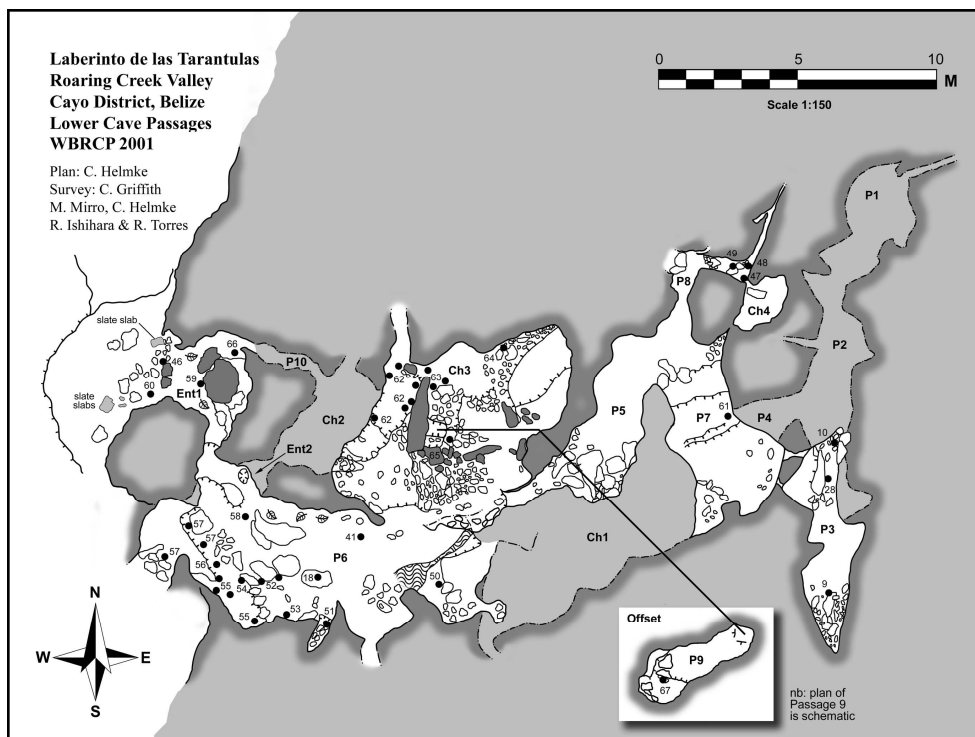


Figure 4.11: Lower cave passages at Tarantula Cave, Cayo District, Belize

Little is known about the prehistory of Barton Creek Valley, located west of Roaring Creek. Thus, the region is an area for future reconnaissance and settlement survey. Aerial and surface investigations east of the lower reaches of Barton Creek, near its confluence with the Belize River, revealed linear field indentations that may represent the remnants of an ancient hydrological system (Kirke 1980). Evidence for intensive agricultural and

hydrological systems in this area is not surprising given the numerous remains of ancient terrace and dam systems in the surrounding uplands. Research conducted at Barton Creek Cave also recorded a small group of mounds on an alluvial terrace surrounding the cave site (Mirro and Mirro 2001). Many of the mounds were in poor condition due to destructive agricultural practices since the 1950s. Three structures, located in a tight cluster of 13 mounds,

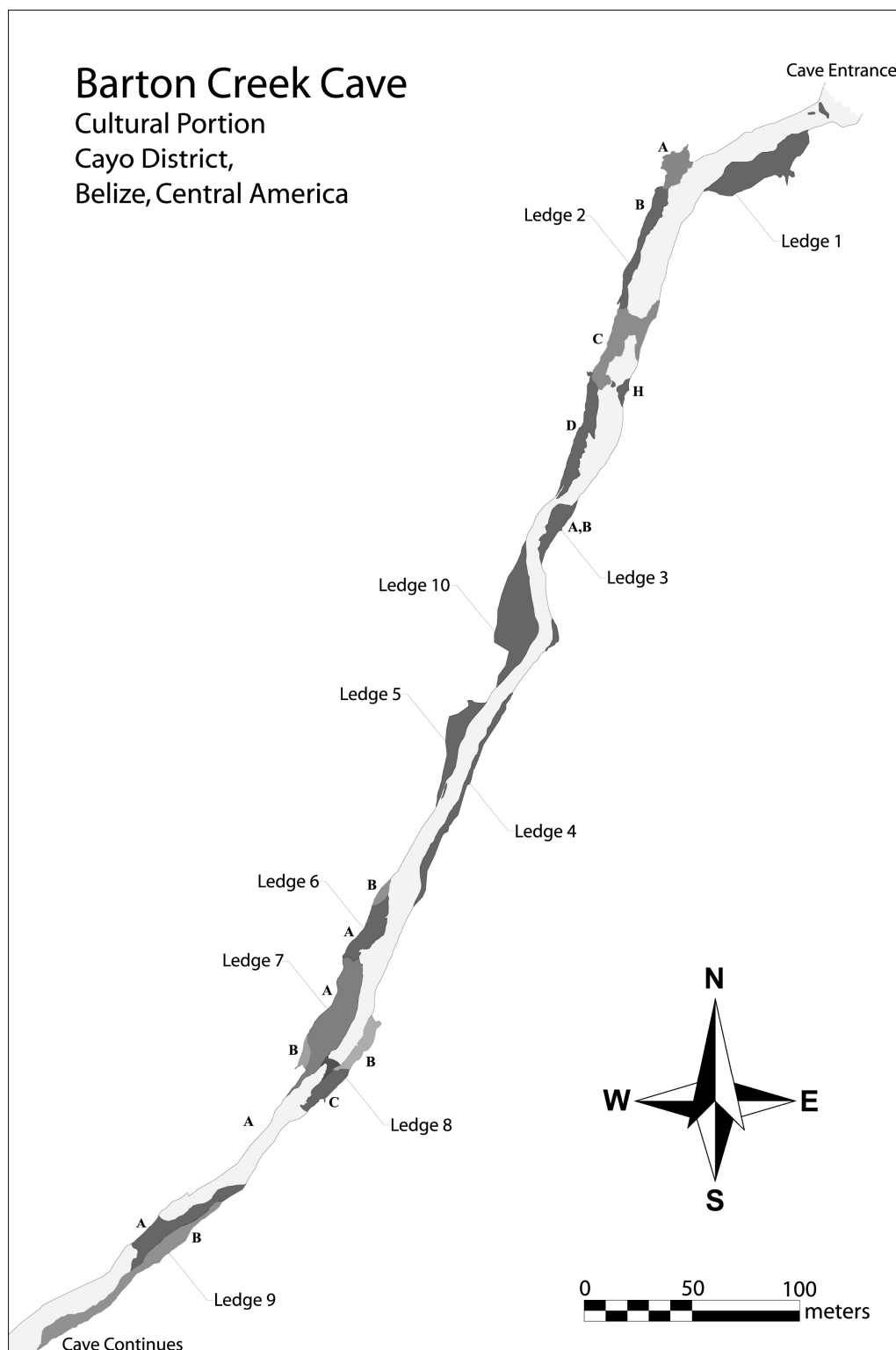


Figure 4.12: Plan map of Barton Creek Cave, Cayo District, Belize, showing ledges with cultural remains.

were selected for test excavations (Mirro and Mirro 2001). Preliminary analyses of the artifactual assemblages date the structures' occupations from the Early Classic period to the Late Classic period. Initial archaeological reconnaissance carried out in the upper Barton Creek Valley discovered a number of unrecorded cave and habitation sites (Mirro and Mirro 2001). Future investigation of these sites is an integral part in developing a regional culture history for Barton Creek Valley.

**Barton Creek Cave.** Barton Creek Cave is a massive, subterranean river system (Mirro and Mirro 2001) (Figure 4.12). The cave may extend up to 20 km in length. Cultural material, however, is restricted to the first kilometer from the entrance. This region of the cave is characterized by numerous stalagmitic formations. Archaeological remains are located on ten narrow, upper ledges that flank the sides of the cave. Archaeological research at Barton Creek Cave focused on



Figure 4.13: Rolling limestone foothills of the Macal River Valley.

reconnaissance, mapping, excavations, and recording and sampling cultural materials. Archaeobotanical remains were collected in conjunction with excavations. Ledges were assigned sequential numbers, and distinct areas of each ledge were assigned letter codes. Formation processes at Barton Creek Cave resulted in stratigraphically shallow deposits.

Many artifacts rest on the surface of the cave's ledges. Archaeological remains include a diverse assemblage of ceramics, ground stone artifacts, flaked stone artifacts, introduced stones or manuports (Mirro 2002), and human remains. Human remains (classified as bone clusters [BC]) consist of single and multiple interments (Owen 2002). The majority of well-preserved bone clusters are primary interments. Many of the human remains are composed of infants and sub-adults.

Chronologically diagnostic ceramics from Barton Creek Cave are primarily associated with the Spanish Lookout phase of the Late Classic period (ca. A.D. 700-800) (Mirro and Mirro 2001), although there are some ceramics attributable to the Early Classic period and Formative period. This distribution suggests that Barton Creek Cave was used more frequently during the Late Classic period.

### **Macal River Valley**

Unlike the relatively minor river systems of Roaring Creek and Barton Creek, the Macal River can be classified as a major river system (Figure 4.1). The cave sites discussed in the present study, Actun Halal, Actun Chapat and Actun Chechem Ha, are positioned north to south along the northerly course of the Macal River and north of the Vaca Plateau, a ridge of Cretaceous limestone with a general height of 1,500 to 2,000 ft.

above sea level (Wright et al. 1959:178). Upland terrain and steep slopes compose the region's physiography (Figure 4.13). Turner (1978:178) describes the limestone foothills and valleys north of the Maya Mountains that approach elevations up to 900 meters above sea level as "flank lands." The calcareous soils of the region are shallow, fertile, and often mixed with colluvial wash from the limestone hills (Wright et al. 1959:179). Erosion in the uplands of the Macal River Valley is more pronounced than in northern alluvial floodplains that follow the eastern course of the Belize River. Deep pockets of soil often remain protected, however, by the large, exposed limestone outcrops that mark the slopes. Areas at the bases of the valley's upland hills are often characterized by the presence of arroyos, dried streambeds that seasonally carry water from the surrounding hills, caves, and subterranean conduits.

Elevation and slope affect the characteristics of the Macal River Valley's forests. In general, the vegetation corresponds to the overall patterns of the greater Upper Belize Valley. The forests are dominated by deciduous, broadleafed, sub-tropical moist forest. Dominant trees consist of a number of economically useful hardwoods, such as mahogany (*Swietenia macrophylla*), cedro (*Cedrela mexicana*), chicle (*Manilkara* sp.), fig (*Ficus* sp.), mylady (*Aspidosperma megalocarpon*), and poisonwood (*Metopium brownie*) as well as palms, including cohune (*Attalea cohune*), botan (*Sabal mauritiiiformis*), and give-and-take (*Cryosophila argentea*). The Macal River Valley is much farther from pine forests than the Roaring Creek and Barton Creek valleys.

One of the most characteristic archaeological features of the rolling uplands in the Macal River Valley is the presence of abundant, ancient agricultural terrace systems and check dams lining arroyos. Similar agricultural

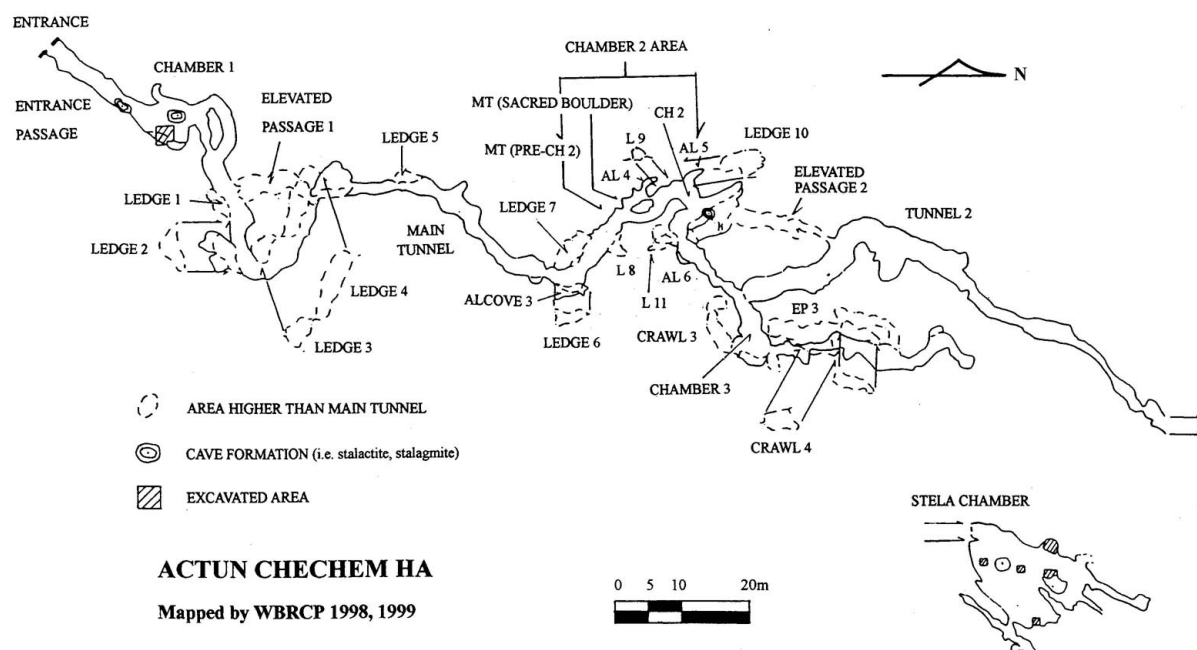


Figure 4.14: Plan map of Actun Chechem Ha, Cayo District, Belize.

features have been recorded throughout the upland zones of the Belize Valley and the Vaca Plateau (Chase and Chase 1998; Fedick 1994; Healy 1983; Neff 1997; Ower 1927; Thompson 1931:228-229; Turner 1978:168-170; Willey et al. 1965:574-575; Wright 1959:112-113). The steep slopes of the Macal Valley flank lands greatly increase the area's susceptibility to erosion, especially when subject to continuous cropping and reduced fallow periods. In order to prevent erosion, agriculturalists must either implement a long-fallow cultivation system or construct terraces to catch eroding soil and nutrient runoff. According to Turner (1978:169), the terraces likely served several primary and secondary functions, such as retaining soil, expanding cultivable land, permitting a dry season crop, reducing the effects of drought, increasing soil depth, and manipulating soil moisture (see also Fedick 1996:8). Although dates for the terrace systems and check dams in the areas immediately surrounding the Macal Valley cave sites are unknown, comparisons with data recovered from similar features in the Belize Valley and Vaca Plateau suggest that their use may have occurred primarily during the Late Classic period when regional population levels were highest (Chase and Chase 1998; Fedick 1994; Healy 1983; Healy et al. 1983; Neff 1997).

The Macal River, one of the primary branches of the Belize River, was extensively populated, with major centers positioned north to south along its course during the Late Classic period. Examples include Cahal Pech, at its lower reaches just south of its confluence with the Mopan River, and Caledonia, at its upper reaches in the Vaca Plateau (Healy et al. 1998). The Macal River may have been a trade route for mineral resources from the Maya Mountains, such as granite for grinding stones, greenstone for elite items, pyrite for mirrors and dental incrustations, and hematite for pigment (Dunham 1996).

Together with the Mopan River Valley, the upper Macal Valley is the location of many of the Belize Valley's significant archaeological sites, including Cahal Pech, Buena Vista del Cayo, Xunantunich, Pacbitun, and Las Ruinas del Arenal (Figure 4.1). Thus, the region was at the center of the social and political dynamics of the Upper Belize Valley during the Classic period. Occupation of the area extends from the Early Formative period (Awe 1992) to the Colonial period occupation of Tipu, located east of the Macal River midway between the Vaca Plateau and the formation of the Belize River (Emery 1999). Although the region may have acquired important resources from the south, the vast majority of political, social, and ideological influences flowed east from Petén, Guatemala (i.e., Naranjo) (see above).

**Actun Chechem Ha.** Actun Chechem Ha is the northernmost cave investigated in the Macal River Valley (Figure 4.14). The cave is located west of the Macal River, high in the steep, limestone foothills of the northern fringe of the Vaca Plateau (Figure 4.1). Actun Chechem Ha was first discovered by a local farmer in 1989 (Ishihara 2000:6). The cave is dry with long narrow passages and steep ledges.

Investigations by the Western Belize Regional Cave Project have continued since 1996. An unusual discovery at Actun Chechem Ha is the presence of an upright, eroded, limestone monument, or "stela," in the cave's largest chamber (Figure 4.15). The "stela" was found in the center of a circular arrangement of stones. Stone circles were found on the cave's ledges as well. Non-perishable artifacts from Actun Chechem Ha consist almost exclusively of ceramics (Ishihara 2000). Many of the ceramics are complete ollas, narrow-necked jars, located on the surfaces of the cave's ledges and tunnels (Figure 4.16). Many other ceramic types are represented in Actun Chechem Ha's pottery assemblage, including





Figure 4.15: Limestone “stela” of Actun Chechem Ha.



Figure 4.16: Intact ollas of Actun Chechem Ha basal flange polychromes and Mount Maloney Black bowls.

Archaeobotanical samples were collected from Actun Chechem Ha. Previous archaeological research by the project involved the sampling of organic residues and matrices from vessel contents. Maize cobs were recovered from inside some ceramic vessels. Intensive archaeobotanical investigations of Actun Chechem Ha were undertaken in June 2000 by the author. Because time did not permit the excavation of stratified deposits, data recovery focused solely on the collection of soil samples from complete vessels located on the surfaces of the cave’s ledges and tunnels. One flotation sample was also taken from a surface hearth in Crawl 3, a narrow interior tunnel (see Figure 4.15). The archaeobotanical data from the 2000 field season were combined with

archaeobotanical remains collected during previous seasons of research.

Ceramics from Actun Chechem Ha date from the Middle Formative period to the Terminal Classic period (ca. 600 B.C.-A.D. 900) (Ishihara 2000), although Formative period, Protoclassic period, and Terminal Classic period ceramics are limited in number. The intensive utilization of Chechem Ha began during the Early Classic period (ca. A.D. 300-600) and increased in the Late Classic period, particularly during the Spanish Lookout Phase (ca. A.D. 700-800). The overall spatial utilization of the cave indicates that areas closer to the entrance were used predominantly during the Early Classic period (Ishihara



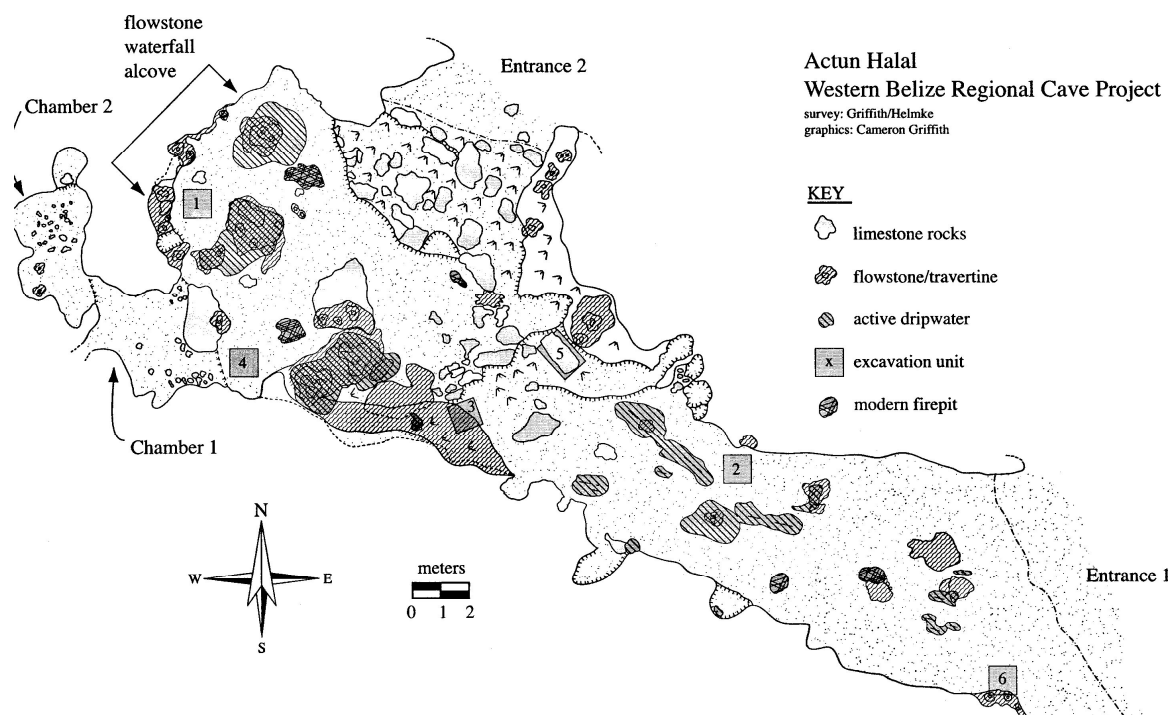


Figure 4.17: Plan map of Actun Halal, Cayo District, Belize.

2000:42). During the Late Classic period, areas deep in the cave experienced intensive use, while areas near the entrance were used less frequently.

Actun Chechem Ha has been characterized as a “rural” cave site (Ishihara 2000:47), in contrast to cave sites associated with ceremonial centers, such as Actun Nak Beh. Actun Chechem Ha may have been used for agricultural rites by the farmers who cultivated the numerous terraces in the Macal River Valley. Although the cave lacks an abundance of artifacts that are traditionally associated with “elite” activities, such as polychrome vessels and jade, there are some exotic, polychrome and ash-tempered wares and a limestone “stela” that may be analogous to stelae dedicated to rulers in urban political centers. The presence of these artifacts raises the possibility that high-status social groups used the cave, although they may not have been rulers (Ishihara 2000:48).

The high number of ceramics at Actun Chechem Ha suggests that the Maya were offering food and beverages to deities (Ishihara 2000:52). Maize remains were recovered from intact vessels. Also, Ishihara (2000, 2001b) suggested that some of the vessels may have functioned as storage containers for *balche*, a mildly alcoholic beverage used in rituals by many modern Maya groups (see Chapter 6). A variety of ritual activities may have occurred in the cave. Moyes (2001) proposed that some areas of the cave, particularly Crawl 3, may have functioned as a ceremonial sweat bath used during purification rites due to the area’s morphological similarities with sweat baths at habitation sites, the presence of hearth features, and the cave’s high humidity.

**Actun Halal.** Actun Halal is located farther downstream from Actun Chechem Ha, west of the Macal River (Figure 4.1). The site is at a lower elevation than Actun Chechem Ha and is uphill from a small arroyo. Many ancient agricultural terraces mark the foothills surrounding Actun Halal.

Actun Halal is a small cave, with two clamshell-shaped entrances at each end of the cave’s primary, 26 m long passage (Figure 4.17). The majority of the cave is in the light zone, although there are two small interior chambers (Chambers 1 and 2) in the penumbral and dark zones. This morphological characteristic of Actun Halal makes the cave appear more similar to a rock shelter than to a cave. Stalactites and stalagmites occur throughout the cave, although present drip-water activity is more common around Entrance 2. The surface of the cave is littered with decaying plant material, insect carcasses, and animal bones.

Archaeological investigations of Actun Halal by the Western Belize Regional Cave Project began in 1999, and research focused on mapping the cave and collecting surface ceramics. Test excavations of the site were undertaken during June 2000 (Griffith and Morehart 2001), and archaeobotanical samples were collected in conjunction with excavations.

The open nature of Actun Halal resulted in destructive formation processes. The lower, central area of the cave was affected by water flowing from the elevated area near Entrance 2. As a result of this erosion, excavation units in this area, especially Unit 2 (Figure 4.17), displayed little stratigraphy, and artifacts were mixed. No sealed archaeological deposits were encountered at the cave.

Although archaeological material at Actun Halal suffers from disturbance, many artifacts were recovered, including ceramics, flaked stone artifacts (including obsidian), and poorly preserved human remains. The majority of ceramic sherds date to the Late Classic period (Ishihara 2001a) (ca. A.D. 600-800). Ceramics attributable to the Formative period and Early Classic period are few. One Late Classic period polychrome ceramic sherd had hieroglyphs similar to Naranjo-style vessels (Ishihara 2001a). The stylistic affinity to Naranjo would be expected given the wealth of data that associate the Upper Belize Valley with areas to the west (see above). A number of rock carvings, or petroglyphs, decorate the walls and drip-water formations of Actun Halal (Griffith and Morehart 2001). The discovery of rock carvings at Actun Halal suggests parallel uses of Actun Halal and other rock shelter-like caves with abundant petroglyphs, such as Actun Uayazba Kan in Roaring Creek Valley (Helmke and Awe 1998) (see Figures 4.1, 4.9).

**Actun Chapat.** Actun Chapat is located west of the Macal River approximately 2-3 km north of Actun Chechem Ha and less than 1 km south of Actun Halal (see Figure 4.1). The cave is about 30 km south of the modern town of San Ignacio (Ferguson 2000). Like Actun Halal, Actun Chapat is lower in elevation than Actun Chechem Ha. Entrances to the cave are located at the bases of foothills that characterize the neighboring area. Numerous ancient terraces and check dams lining arroyos mark the foothills surrounding Actun Chapat.

Actun Chapat is massive; a comprehensive map of Actun Chapat is still under preparation. The cave has two known entrances, although there may be additional, undiscovered points of access (Cameron Griffith, personal communication 2001). Entrance 1 is located along the same arroyo that flows past Actun Halal. Entrance 2 is a sinkhole that must be accessed with a ladder or climbing equipment. The cave also has a large, unexplored subterranean lake.

The Belize Department of Archaeology initiated preliminary reconnaissance of Actun Chapat in 1982 (Awe 1998:8). Investigators recorded many archaeological materials, including architecture, ceramics dating from the Late Formative period to the Late Classic period, and fragmented human remains. In 1999, the Western Belize Regional Cave Project began systematic research at Actun Chapat (Ferguson 2000, 2001). The 1999 investigations focused on a comprehensive site map, test excavations, and surface collection of the area inside Entrance 2. The most notable archaeological characteristic of this area is the presence of substantial architectural terraces. Actun Chapat is unique because the site contains platforms, stairs, benches, and over 30 terraces, the largest known concentration of cave architecture in western Belize. Test excavations of undisturbed terraces revealed well-defined stratigraphy. In some archaeological units, the depth of stratigraphy follows temporal ceramic sequences closely (Ferguson

2000). Thus, architecture provides the opportunity to obtain archaeological samples from stratified deposits, a feature lacking at many cave sites.

Ceramic data from Entrance 2 suggest that this area was used from the Middle Formative period to the Late Classic period (ca. 600 B.C.-A.D. 900) (Ishihara 2001a). Further, ceramic evidence demonstrates that the use of and construction of the terraces changed through time. The level cave floor at the base of the terraces was used predominantly in the Formative period. During the Early Classic period (ca. A.D. 300-600), the Maya began to construct the lower terraces, and, in the Late Classic period (ca. A.D. 600-900), they used the highest terraces in Entrance 2.

During the 2000 field season, archaeological research at Actun Chapat was carried out in Chamber 3B, located in the dark zone approximately 120 km from Entrance 1 (Ferguson 2001). Chamber 3B is the southern most area of the larger Chamber 3. Chamber 3B is about 20 x 15 m and is defined by the cave wall and by large concentrations of rock breakdown. Investigations of this area produced the botanical assemblage included in the present study.

Architectural terraces are abundant in Chamber 3B. The terraces are substantially fewer in number and smaller in size than those of Entrance 2. Three test excavation units were established in Chamber 3B (Ferguson 2001). Unit 11 was placed on Terrace 26 in a previously looted area in order to salvage archaeological material. Units 10 and 12 were in undisturbed locations. Unit 10 was placed on Terrace 20. Unit 12 was located on the cave floor in front of an artificially walled-off chamber. Test excavations of undisturbed units yielded well-defined stratigraphy that appeared to represent successive burning episodes.

Chronologically diagnostic ceramic data are not extensive from Chamber 3B (Ishihara 2002). Those few ceramics that can be associated with time periods suggest that the area tested in Unit 10 extends from the Late Formative period to the Early Classic period (ca. 300 B.C.-A.D. 600). Ceramics found on the surface and in shallow levels of Unit 12 indicate that the area was used during the Late Classic period (ca. A.D. 600-900). Radiocarbon analysis of charcoal from Unit 10, Level 3, yielded a date of  $1530 \pm 60$  BP (Cal. A.D. 410-650, 2 sigma range) (Beta-164696), whereas radiocarbon analysis of charcoal from Unit 12, Level 3 yielded a date of  $1240 \pm 70$  BP (Cal. A.D. 660-970, 2 sigma range) (Beta-164695) (Appendix D). Thus, the radiocarbon samples support the ceramic evidence that the areas tested by Units 10 and 12 were used at different times.

## Summary

The Upper Belize Valley offers a unique opportunity to explore the nature of ritual activities and the role of caves in the social, political, and ecological conditions affecting the southern Maya Lowlands. The Late Classic period was a time of environmental stress and political

instability. Caves offer insight into the forces at work at the peak and decline of Classic period Maya civilization. The Maya of the Upper Belize Valley reacted to social, political, and environmental stresses by increasing ceremonial activities in the abundant caves of the region. Cave rituals during this time likely served several functions. Offerings conducted to agricultural deities probably increased to petition for rain and a productive harvest. The use of caves also provided an avenue for political competition. Groups attempting to maintain power, and groups struggling to assert themselves as powerful appropriated cave symbolism in order to establish an ideology that justified their hegemonic status.

Seven cave sites from three river valleys in the greater Upper Belize Valley were sampled for archaeobotanical remains. The wide geographical distribution of the caves permits the evaluation of regional trends in the archaeobotanical assemblage. The incorporation of archaeobotanical data with other archaeological artifacts and features on a regional level will assist not only in understanding ritual plant utilization but will provide a broader understanding of the nature of cave rituals in the Upper Belize Valley.

## CHAPTER 5

### ARCHAEOBOTANICAL INVESTIGATIONS

This chapter presents the methods and results of archaeobotanical investigations in the seven cave sites sampled in the Upper Belize Valley. First, field, laboratory, and general analytical methods are outlined. This research is the first study to apply systematic sampling and recovery procedures to cave sites in the Maya Lowlands. Investigations included flotation sampling and the collection of excavated charred macrofossils. In addition, sophisticated techniques for identification, such as starch grain analysis and residue analysis, were employed. Some cave sites were more systematically sampled for botanical remains than others, and some caves' assemblages are better preserved than others. These site-specific variations limit this methodological section to some extent. Second, results of identifications and analyses are presented on intrasite and intersite levels. This section also provides more specific discussion of the application of methodological techniques. (Appendix D provides definitions of terminology used in this chapter).

The archaeobotanical data document the relative abundance of burned wood in caves, especially pine, using ubiquity and weight comparisons. A number of well-preserved remains of domesticated plants are represented in the archaeobotanical assemblage. Maize was the most frequently encountered domesticated cultigen, and variability in its morphology suggests the development of larger cobs over time. The Maya may also have been growing multiple types of maize. The data also provide evidence of the significance of fruit trees in Maya ritual life through the association of charred fruits in a burial and indirectly through the presence of burned wood from economically useful fruit trees. A fragment of a cotton textile found with numerous carbonized domesticated cultigens reinforces the role of textiles in ritual as demonstrated in ancient iconography and modern ethnography.

#### Field Methodology

##### *Flotation Sampling*

One-liter soil samples were collected from archaeological contexts. Soil samples were processed using a manual flotation system (Pearsall 2000; Struever 1968). A small, three-gallon bucket was modified by removing the bottom and attaching 1/16-inch nylon window screen with marine sealant. While in the field, local water sources were utilized to process samples. While in the lab, a 55-gallon steel drum was used. In order to prevent contamination, water in the drum was changed every one to three samples depending on the composition of the sample. The small bucket was immersed in the water source and agitated in a clockwise/counter-clockwise rotation. Soil was poured in slowly until the entire sample was processed. The light fraction was removed with a fine mesh sieve and placed

on a small, water-permeable, cloth square. The heavy fraction was gently poured into a larger cloth square. Both light and heavy fractions were tied on a line and allowed to air dry. Once dry, heavy fractions were sorted for residual archaeobotanical remains. These materials were collected and added to their respective light fractions. The remaining heavy fractions were returned to field supervisors for artifactual analysis. Light fractions were stored for exportation.

##### *Excavated Charcoal*

All carbonized plant remains encountered during excavations were recovered for radiocarbon dating. Radiocarbon samples were later sub-sampled for botanical analysis. Charred material was wrapped in aluminum foil and placed in labeled bags. Samples were then stored in a dry location in the project laboratory for subsequent analysis. All samples from sub-sampled radiocarbon samples are referred to here as macrofossil samples.

##### *Matrix from Complete Vessels*

Matrices in complete ceramic vessels located on ledges in Actun Chechem Ha were collected to obtain macrofloral and microfloral remains. Due to the varying amount of soil found in these vessels, the amount of matrix in each vessel dictated the size of the sample. Samples were wrapped in acid-free paper and aluminum foil, placed in labeled paper and plastic bags, and stored in the project laboratory for later analysis.

#### Data Analysis

Identification of all botanical remains took place at the New York Botanical Gardens, Bronx, New York. Samples were assigned five-digit botanical identification numbers. Macrofossil sample I.D. numbers were initiated at 10001 and flotation samples at 20001. Samples were sorted using a stereomicroscope at low magnification. Distinct taxonomic groups within samples were enumerated sequentially and appended to the sample identification number. For instance, if sample 10003 contained pine charcoal and maize kernels, the two groups would be recorded as 10003-001 and 10003-002, respectively.

##### *Wood Charcoal*

Carbonized wood dominated sample composition from all cave sites. Wood charcoal specimens were fractured in order to reveal anatomical characteristics in transverse section (Figure 5.1). Features examined included the presence, size, density, overall distribution, and patterning of vessels (multicellular, conducting structures in the xylem of angiosperms), the size and density of rays (radially distributed parenchyma cells in the secondary body of stems), the types of axial parenchyma (non-lignified cells in the secondary body of stems that exhibit distinct patterns), and the presence or absence of resin

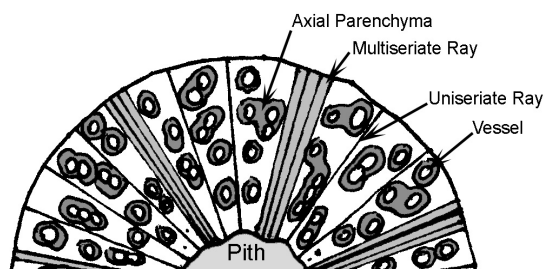


Figure 5.1. Drawing of angiosperm wood in cross-section displaying anatomical characteristics useful for identification.

ducts (long canals that contain resin in gymnosperms). Specimens were then cross-referenced with Dr. David Lentz's Central American wood collection and with reference texts on neotropical woods (Carreras and Dechamps 1995; Détienne and Jacquet 1983; Uribe 1988) for taxonomic determinations. A scanning electron microscope, located at the New York Botanical Garden's Harding Laboratory, was employed in order to assist in identification of difficult specimens. All gymnosperm charcoal was identified as pine (*Pinus* sp.), indicated by the lack of vessels, the homogenous distribution of tracheids, and the uniform presence of resin ducts. Not all specimens of hardwood charcoal were identified due to the high diversity of hardwood flora in the southern lowlands of Mesoamerica. Most specimens were identified to genus, and very few were identified to species. Frequently, however, identification was unable to proceed beyond the botanical family or the designation "hardwood" due to either poor preservation or the lack of comparative wood specimens (See Appendix B).

In order to evaluate the wood charcoal assemblages, charcoal was compared at different analytical scales: hardwood versus pine charcoal, comparisons of individual genera of wood charcoal, and under-developed versus mature wood. Due to sampling and preservation differences, analyses varied depending on the characteristics of individual cave assemblages. More specific discussions of analytical methods are presented in the results section.

The first analysis is based on the contributions of pine (*Pinus* sp.) charcoal and hardwood charcoal to the charcoal assemblage from each cave site. Comparisons of pine versus hardwood charcoal provide a general pattern of wood utilization and extraction because hardwoods are more locally available than pine in the Upper Belize Valley (see Chapter 4). Also, by grouping all hardwood taxa together, specimens of hardwood charcoal that were not identified to a more specific taxonomic level may be compared.

The second comparison examines the contributions of individual, identified genera of wood charcoal to the charcoal assemblage from each cave site. This analytical methodology is intended to identify more culturally

meaningful patterns in charcoal assemblages. Ethnobiological studies have demonstrated that in indigenous folk taxonomies, the generic level or rank is culturally and cognitively the most salient (Anderson 2000:138; Atran 1999:47-48; Berlin 1992; Berlin et al. 1974:27; D'Andrade 1995:95). The generic level is where relationships in morphology, behavior, and ecology between organisms maximally co-vary (Atran 1999:47-48). Segregation between taxa at the generic rank depends on a number of factors, such as anatomy, developmental cycles, habitat, and use. Generics are the basic units of all folk taxonomies, and they are the most commonly recognized groupings of organisms (Berlin et al. 1974:27). Stross (1973) has shown that generic taxa are often the first to be learned by children.

A potential criticism of this approach is that archaeobotanical identifications based on western scientific taxonomies may not correspond to emic classifications of plants in ancient Maya folk taxonomies. Although there is never a direct congruence between scientific and folk classificatory systems, many researchers have observed a great degree of similarity between both types of systems, a condition that may be the result of cross-culturally universal cognitive processes. In Tzeltal Maya ethnobotany, for example, Berlin et al. (1974:101-102) found that of 471 folk generics, 291 correspond to scientific species, and 65 correspond to two or more species in the same scientific genus. Anderson (2000) observed that 63 of 89 bird genera in Yucatec Maya folk taxonomies match exactly with scientific species. In addition to the congruence between scientific and folk systematics, Atran (1999:55-56) has argued that folk taxonomies used by modern Maya groups have deep roots in the prehistoric past, a factor that provides firmer support for the application of ethnographic analogues to archaeobotanical data.

When possible, comparisons of pine versus hardwood charcoal and comparisons of individual hardwood genera are based on ubiquity analysis and weight measurements. Ubiquity analysis examines the number of analytical units in which a taxon appears out of all analytical units (Popper 1988:61). Ubiquity values are normally expressed as a percentage. Researchers commonly use individual archaeobotanical samples as analytical units. In this study, however, multiple archaeobotanical samples were often recovered from single archaeological deposits. Using archaeobotanical samples as analytical units might either inflate or deflate ubiquity values of taxa from such deposits. As a result, individual archaeological deposits or contexts are employed here as analytical units in ubiquity comparisons.

Weight measurements compare the weight, in grams, of macrofloral material. It is best to use botanical weights from standardized flotation samples rather than from samples of excavated charcoal (macrofossil samples) because the collection of charred material during excavations is often inconsistent (Smart and Hoffman 1988). In this study, soil samples were standardized at

one-liter. For most taxa, weight values are expressed as grams per liter. Multiple one-liter samples were sometimes recovered from single archaeological deposits. In these cases, taxa weights were standardized by dividing the weight of the taxon being measured by the number of samples from that deposit. For example, if four flotation samples recovered from “Feature 2” yielded a total of 12.4 g of pine charcoal, the standardized weight of pine would be  $12.4 / 4$ , or 3.1 g. Finally, charcoal taxa were sometimes retrieved from excavated macrofossil samples but not from flotation samples. In this situation, relying solely on flotation samples would eliminate taxa from weight comparisons. Consequently, the overall weight of wood charcoal was used when flotation samples did not contain a representative sample of wood taxa for comparison.

A final comparison of charcoal remains examines the contribution of immature stems or branches versus mature stems to the charcoal assemblage. The level of wood development may reflect a number of cultural and environmental circumstances, such as form preferences, especially as it relates to function, and resource availability (Metzger and Williams 1966; Smart and Hoffman 1988). The maturity of wood charcoal is easily discernible. Underdeveloped specimens have small diameters. The wood’s narrow diameter causes the radiation of rays and vascular anatomy from the central pith region to appear markedly pie-shaped in cross-section (Figure 5.1). In some archaeobotanical specimens the pith region may be preserved, a clear indication that the specimen is from an immature stem or branch. The weights of underdeveloped and mature wood charcoal were recorded. Comparisons are based on the proportion of each wood type out of the total amount of charcoal (e.g., underdeveloped charcoal weight [in grams] / total charcoal weight [in grams]).

## Maize

Maize (*Zea mays*) remains were measured with calipers for morphological analysis (Figure 5.2). Quantitative and qualitative measurements follow those applied by Benz (1986), Bird (1994), Bird and Bird (1980), Miksicek et al. (1981), and Wellhausen et al. (1952). Quantitative measurements include ear, cob, and rachis diameter; cupule width, length, and angle; cupule wing width; glume width; cob length; row number; and kernel angle, width, length and thickness. Qualitative measurements include cob cross-section shape; cob longitudinal shape; and kernel crown shape.

Maize attributes were compared with one another using bi-variate analysis to uncover relationships among archaeobotanical specimens. Paired, quantified attributes were selected and graphically plotted in order to reveal possible groups of morphologically similar specimens. Due to inter-site and intra-site differences in maize preservation, measurements made on some specimens were not possible on others. The selection of attributes to plot was based on those that were common to most specimens.

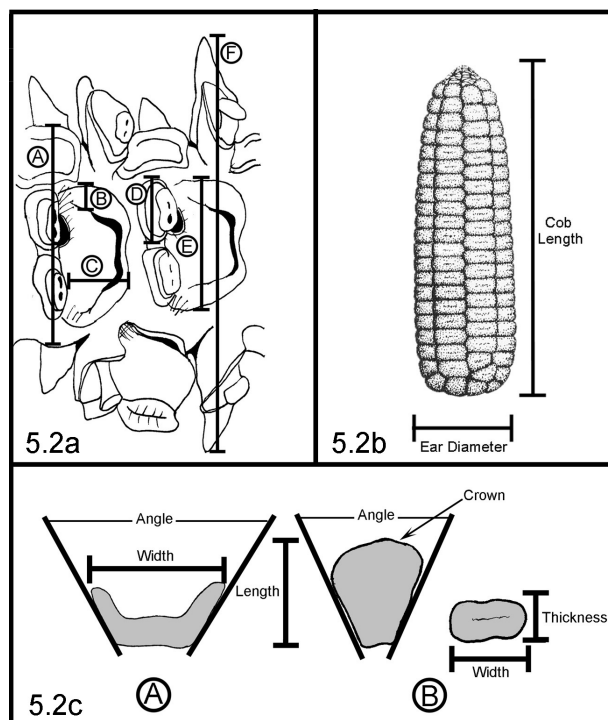


Figure 5.2: 5.2a: View of maize cob without chaff and kernels displaying morphological attributes measured, A= rachis diameter, B= cupule wing width, C= cupule length, D= glume width, E= cupule width, F= cob diameter (redrawn from Bird and Bird 1980:Figure 1). 5.2b: Maize ear showing external cob measurements (redrawn from Bird 1984:Figure 6g). 5.2c: Additional measurements of cupule (A) and kernel (B).

Measurements were compared to prehistoric maize from the Maya region in order to reveal affinities with other ancient maize types (Appendix C). Morphological analysis of archaeological maize from the Maya region is infrequent. In addition, there is no standardization in the types of measurements recorded. Available metric measurements are often from external cob attributes, such as kernel width, length, and thickness, cob length and width, and row number. Data on internal cob attributes, such as cupule width and length, cupule wing width, and glume width, are not abundant. Nevertheless, comparisons can be made with other archaeological specimens. The Formative period site of Cuello yielded maize dating from ca. 1100 B.C. to A.D. 250 (Miksicek 1991:Table 4.3; Miksicek et al. 1981). Researchers at Cuello recorded a number of internal cob characteristics comparable to maize from the cave sites. Metric data on maize remains from Late Classic period contexts at Copán (Lentz 1991:272) and Wild Cane Cay (McKillop 1994:134-135) and Early Classic period deposits at Cerén (Lentz et al. 1996a:253) are limited to external cob measurements such as row number and kernel width and thickness. Nevertheless, these data are compared to the cave maize where applicable.

Maize from the cave sites was compared to extant maize races in order to establish racial affinities with modern varieties. Races that are examined include measurements

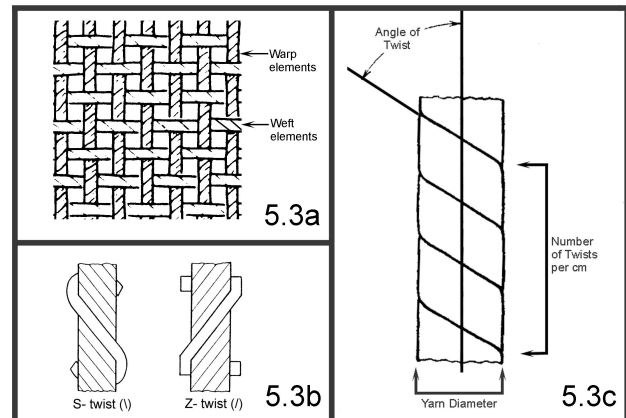
from a specimen of Nal Tel maize collected by the author in northwest Quintana Roo, Mexico; measurements on Nal Tel, Chapalote, Dzit Bacal, and Arrocillo described by Benz (1986); and measurements on Chapalote, Nal Tel, and Arrocillo Amarillo provided by Wellhausen et al. (1952) (Appendix C) (Wellhausen et al.'s Arrocillo Amarillo is the same as Benz's Arrocillo). Comparative external and internal maize measurements are available for both the author's Nal Tel and all the maize recorded by Benz. Benz provides high and low ranges for measurements rather than averages. Consequently, median values were equated in order to utilize his data for bi-variate comparison. Wellhausen et al. (1952) provides external cob measurements only.

The races Arrocillo [Amarillo], Chapalote, Dzit Bacal, and Nal Tel were selected for comparison for various reasons. Arrocillo, Chapalote, and Nal Tel have long been considered ancient races (Wellhausen et al. 1952; Mangelsdorf 1974). Most maize recovered from archaeological sites in the Maya Lowlands has been identified as either Nal Tel or Chapalote (Lentz 1999:4). Chapalote, Nal Tel, and Dzit Bacal are lowland, early-maturing types, and Nal Tel and Dzit Bacal are still grown in the Maya Lowlands today. Arrocillo is a highland variety.

Metric data recorded for the cave maize were inflated 20% to correct for post-depositional shrinkage in order to compare the archaeological maize to measurements of modern maize races. Numerous researchers have employed correction factors to accommodate for shrinking caused by carbonization. Cutler and Blake (2001) observed that maize cobs shrink from 15 to 20% when burned. Miksicek et al. (1981) applied a 20% correction in order to compare maize from Cuello to modern races. Benz (1994:28) employed experimental conditions to determine the degree of shrinkage for modern Mexican maize and found that the amount of shrinkage over all morphological cob attributes recorded falls between 15 and 25%. Benz also concluded that maize races and individual morphological features shrink differentially and that the use of a single correction factor for all attributes increases the probability of misclassifying a specimen. Nevertheless, a standard 20% increase is used in this study to associate the cave maize tentatively with modern varieties. Both corrected and uncorrected metric values are provided. The correction factor was not applied in comparisons among archaeological specimens alone.

### Textiles

Analysis of a textile fragment recovered from Barton Creek Cave followed guidelines discussed by King (1978), Emory (1980), Kuttruff (1993) and Kuttruff and Strickland-Olsen (2000:28-30). Various measurements were recorded in order to describe the textile fragment, including the number of weft (transverse) and warp (longitudinal) elements per cm<sup>2</sup>, the diameter of warp and weft elements, the direction of twist (either Z or S) for



Figures 5.3: 5.3a: Plain weave displaying longitudinal warp elements and transverse weft elements (redrawn from Wild 1988:Figure 30). 5.3b: Diagram displaying direction of twist, either S or Z. (redrawn from Emory 1980:Diagram 1). 5.3c: Diagram of plied yarn showing additional measurements (redrawn from Emory 1980:Diagram 2).

spun single threads and plied composite yarns, and the number of twists per cm and the angle of twist for plied composite yarns (Figure 5.3). The dominant weaving technique was recorded. Lastly, fibers were documented and illustrated with scanning electron microscopy.

### Starch Grain Analysis

Unfloated matrices collected from complete vessels and residues scraped from ceramic sherds from Actun Chechem Ha were processed for preliminary starch grain analysis. Soil extraction techniques followed guidelines explained in Therin et al. (1999) (see also Piperno et al. 2000). One thousand µl of aqueous Cesium chloride (CsCl) at a specific gravity of 1.7 was added to 1 g of soil. The solution was centrifuged for 100 seconds at 400 rpm. The supernatant was removed with a pipet, placed in sterile vials, diluted with 200 µl of distilled water, and centrifuged at 13,000 rpm for 80 seconds in order to force starch to the bottom of the vial. The supernatant was extracted, leaving microflora in the bottom of the vial. A drop of the remaining liquid was mounted on a microscope slide with diluted iodine and viewed at high magnification. Residue scrapings were wet mounted with diluted iodine, macerated by applying light pressure to the cover slip, and viewed at high magnification. Archaeological starch grains were compared to modern material and descriptions of starch grains in reference texts (e.g., Reichert 1913). Comparative material was prepared by scraping starchy roots and the starchy endosperms of seeds onto a microscope slide with a sterile razor blade.

### Residue Analysis

Geoffrey C. Klein and TuKiet T. Lam of the National High Magnetic Field Laboratory, Tallahassee, Florida, analyzed samples of unidentified carbonized residues

Table 5.1: Archaeobotanical Remains from Actun Chapat, Cayo District, Belize. CH= chamber, T= terrace, U= excavation unit, L= excavation level, EC= Early Classic period, LC= Late Classic period, – = unquantified.

| Provenience        | Plant                                                                                                                                                                                                                                            | Part                                                                                                                                                        | Weight                                                                                                                   | #                                                                   | ID Number           | Time Period   | Comments                                       |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------|---------------|------------------------------------------------|
| CH3B, T20, U10, L2 | <i>Pinus</i> sp.<br><i>Byrsonima</i> sp.<br><i>Cedrela</i> sp.<br>Leguminosae                                                                                                                                                                    | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal                                                                                                                | 0.1<br>0.02<br>0.1<br>0.25                                                                                               | -<br>-<br>-<br>-                                                    | 10069               | EC            |                                                |
| CH3B, T20, U10, L3 | <i>Pinus</i> sp.<br><i>Piscidia</i> sp.<br><i>Albizia</i> sp.<br><i>Protium</i> sp.<br><i>Quercus</i> sp.<br>Burseraceae<br>Euphorbiaceae<br>Leguminosae<br>Hardwood<br>Dicot<br><i>Zea mays</i><br><i>Zea mays</i><br>Dicot<br>Dicot<br>Unknown | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Cupules<br>Glumes<br>Floral Bud<br>Rind<br>Seed | 0.08<br>0.08<br>0.01<br>0.05<br>0.06<br>0.03<br>0.14<br>0.13<br>0.35<br>0.01<br>0.03<br>0.01<br>0.01<br>> 0.01<br>> 0.01 | -<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>16<br>3<br>1<br>-<br>2 | 10070, 20048        | EC            | 1530± 60 BP                                    |
| CH3B, T20, U10, L4 | <i>Pinus</i> sp.<br><i>Tabebuia</i> sp.<br><i>Protium</i> sp.<br>Hardwood<br><i>Zea mays</i><br><i>Zea mays</i><br><i>Zea mays</i><br><i>Cucurbita</i> sp.<br>Unknown                                                                            | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Kernel<br>Cupule<br>Cob frag<br>Rind<br>Seed                                                                | 0.12<br>0.08<br>0.15<br>0.13<br>0.01<br>0.01<br>0.01<br>0.01<br>> 0.01                                                   | -<br>-<br>-<br>-<br>4<br>6<br>1<br>-<br>1                           | 10071, 20049        | EC or earlier |                                                |
| CH3B, T20, U10, L6 | <i>Pinus</i> sp.<br><i>Allophylus</i> sp.<br>Leguminosae<br>Hardwood<br>Dicot<br><i>Zea mays</i>                                                                                                                                                 | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Rind<br>Cupule                                                                                              | 0.35<br>0.04<br>0.08<br>0.09<br>0.03<br>> 0.01                                                                           | -<br>-<br>-<br>-<br>-<br>1                                          | 10072, 20050        | EC or earlier |                                                |
| CH3B, T26, U11, L6 | <i>Pinus</i> sp.<br><i>Byrsonima</i> sp.<br><i>Cordia</i> sp.<br><i>Piscidia</i> sp.<br><i>Tabernaemontana</i> sp.<br><i>Zanthoxylum</i> sp.<br>cf. Rubiaceae<br>Hardwood<br><i>Zea mays</i><br><i>Phaseolus</i> sp.                             | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Kernel<br>Seed                                              | 0.05<br>0.11<br>0.03<br>0.05<br>0.42<br>0.46<br>0.04<br>0.25<br>> 0.01<br>0.01                                           | -<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>2<br>1                      | 10076, 20055, 20056 | n.a.          | Floor<br><br><br><br><br><br><br><br>Fragments |
| CH3B, U12, L3      | <i>Pinus</i> sp.<br><i>Byrsonima</i> sp.<br><i>Protium</i> sp.<br><i>Tabernaemontana</i> sp.<br><i>Zanthoxylum</i> sp.<br>Leguminosae                                                                                                            | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal                                                                                        | 0.21<br>0.37<br>0.44<br>1.38<br>0.07<br>0.21                                                                             | -<br>-<br>-<br>-<br>-<br>-                                          | 10077, 20057        | LC            | 1240 ± 70 BP                                   |



Table 5.1  
cont'd

| Provenience           | Plant                      | Part       | Weight | # | ID Number    | Time Period | Comments              |
|-----------------------|----------------------------|------------|--------|---|--------------|-------------|-----------------------|
| CH3B, U12, L3, cont'd | Rubiaceae                  | Charcoal   | 0.07   | - |              |             | 4fragment, 1whole     |
|                       | Hardwood                   | Charcoal   | 5.73   | - |              |             |                       |
|                       | <i>Zea mays</i>            | Kernels    | 0.04   | 5 |              |             |                       |
| CH3B, U12-ext, L3     | <i>Pinus</i> sp.           | Charcoal   | 0.03   | - | 10078, 20058 | LC          | Associated with cache |
|                       | <i>Piscidia</i> sp.        | Charcoal   | 0.11   | - |              |             |                       |
|                       | <i>Tabernaemontana</i> sp. | Charcoal   | 0.16   | - |              |             |                       |
|                       | Anacardiaceae              | Charcoal   | 0.43   | - |              |             |                       |
|                       | Meliaceae                  | Charcoal   | 0.14   | - |              |             |                       |
|                       | Rubiaceae                  | Charcoal   | 0.14   | - |              |             |                       |
|                       | Sapotaceae                 | Charcoal   | 0.62   | - |              |             |                       |
|                       | Hardwood                   | Charcoal   | 1.07   | - |              |             |                       |
|                       | <i>Zea mays</i>            | Kernel     | > 0.01 | 1 |              |             | Fragment              |
|                       | Dicot                      | Floral Bud | > 0.01 | 1 |              |             |                       |
| CH3B, U12, L4         | <i>Pinus</i> sp.           | Charcoal   | > 0.01 | - | 10079, 20059 | LC          | Fragments             |
|                       | <i>Byrsonima</i> sp.       | Charcoal   | 0.3    | - |              |             |                       |
|                       | <i>Cassia</i> sp.          | Charcoal   | 0.94   | - |              |             |                       |
|                       | <i>Licaria</i> sp.         | Charcoal   | 0.43   | - |              |             |                       |
|                       | <i>Matayba</i> sp.         | Charcoal   | 1.08   | - |              |             |                       |
|                       | <i>Tabernaemontana</i> sp. | Charcoal   | 3.32   | - |              |             |                       |
|                       | <i>Zanthoxylum</i> sp.     | Charcoal   | 0.38   | - |              |             |                       |
|                       | Araliaceae                 | Charcoal   | 0.22   | - |              |             |                       |
|                       | Euphorbiaceae              | Charcoal   | 2.33   | - |              |             |                       |
|                       | Leguminosae                | Charcoal   | 0.69   | - |              |             |                       |
|                       | Rubiaceae                  | Charcoal   | 0.23   | - |              |             |                       |
|                       | Hardwood                   | Charcoal   | 5.47   | - |              |             |                       |
|                       | <i>Zea mays</i>            | Kernels    | > 0.01 | 2 |              |             |                       |

from Actun Nak Beh, Barton Creek Cave, and Actun Chechem Ha using Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) (Hendrickson et al. 1998). FT-ICR MS measures the molecular mass of chemical compounds. Molecular mass of constituent compounds, expressed in Daltons, is displayed in a spectragraph as a series of peaks. Each peak corresponds to a particular molecular mass value. By analyzing archaeological and modern materials, the spectra of unknown and known materials can be compared for similarities in molecular mass. Comparative material was selected based on the possibility that the residues may be the remains of either burned pine sap or copal incense, traditionally made from the sap of species in the Burseraceae plant family. Comparative material included a Caribbean pine (*Pinus caribaea*) cone, the bark of the gumbo limbo tree (*Bursera simaruba*) and the copal tree (*Protium copal*), and a sample of copal incense obtained from highland Guatemala. The FT-ICR MS comparisons are preliminary and are expressed as the percentage of peaks (molecular mass) held in common between archaeological and modern material. Although similarities in molecular mass can be compared, the identification of the actual chemical compounds that were measured must await further analysis.

## Intrasite Comparison of Archaeobotanical Remains

### Actun Chapat

Archaeobotanical recovery at Actun Chapat, Chamber 3B, included the collection of one-liter flotation samples per unit-level and the retrieval of carbonized macrofossils encountered during excavations. A total of twelve flotation samples from ten archaeological deposits and twelve macrofossil samples from eleven deposits were analyzed (Appendix A). The results are presented in Table 5.1. A number of deposits from Unit 11 were disturbed due to looting (Ferguson 2001). Disturbed contexts are noted in Appendix A but not included in Table 5.1. Level 6 of Unit 11, however, was beneath a preserved floor and is not disturbed. Overall, the archaeobotanical assemblage from Actun Chapat is noteworthy because plant material is well preserved. Stratigraphy was clearly defined and appeared as successive layers of burning episodes (Ferguson 2001).

As discussed in the previous chapter, Actun Chapat has deposits representing two chronological time periods. Although diagnostic ceramics from Chamber 3B were scarce, general temporal patterns can be observed (Ishihara 2002). Early Classic period ceramics were

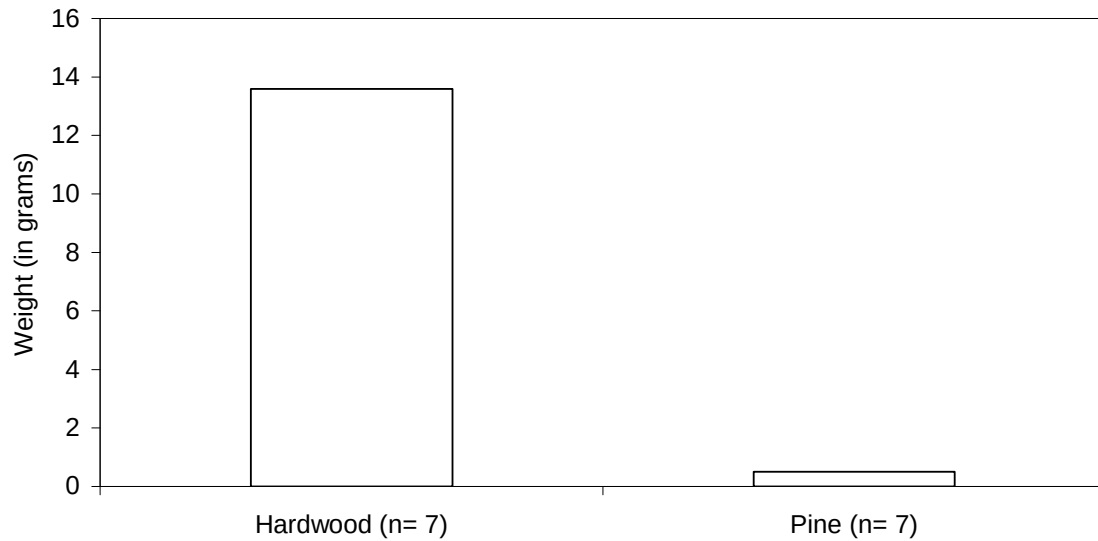
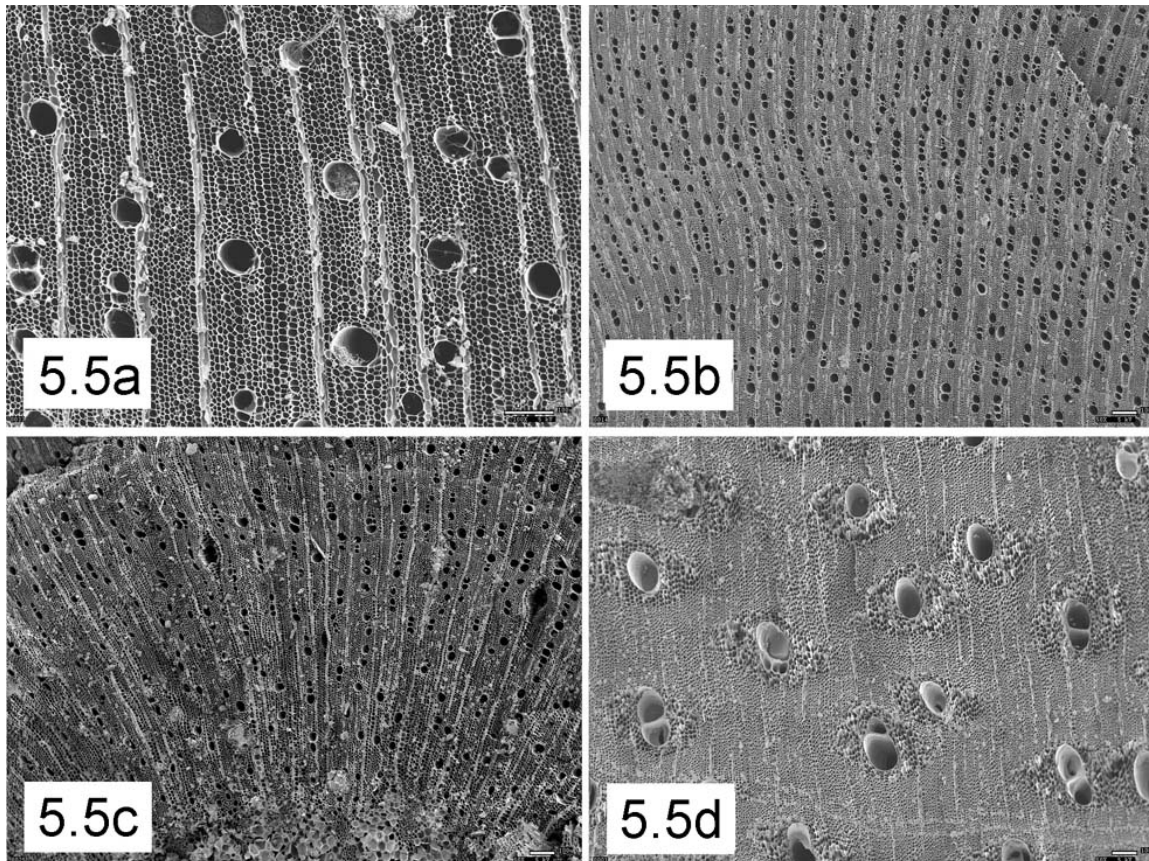


Figure 5.4: Differences in hardwood and pine charcoal from one-liter flotation samples measured by weight.



Figures 5.5: Charcoal specimens from Actun Chapat. 5.5a: *Protium* sp. X100 (10077-004). 5.5b: *Tabernaemontana* sp. X50 (10076-002). 5.5c: *Zanthoxylum* sp. X50 (10079-015). 5.5d: *Cassia* sp. X50 (10079-001).

collected from Level 1 of Unit 10, located on Terrace 20, but no archaeobotanical data are available from this level. Late Formative period ceramics were found in Level 2, which is represented in the botanical assemblage. No other levels in Unit 10 yielded identifiable ceramics. Radiometric analysis of charcoal from Unit 10, Level 3 yielded a date of  $1530 \pm 60$  BP (Cal. A.D. 410-650, 2 sigma range) (Beta-164696) (Appendix D). Although this

date is somewhat later than would be expected based on ceramic evidence, it does fall into the Early Classic period (A.D. 300-600). Unfortunately, no chronology is available for Unit 11's only undisturbed deposit (Level 6). Diagnostic ceramics from Unit 12 are also few. Ceramics from the unit's surface and shallow levels date to the Late Classic period. Thus, Unit 12's date is probably no later than the Late Classic period and may be exclusively Late

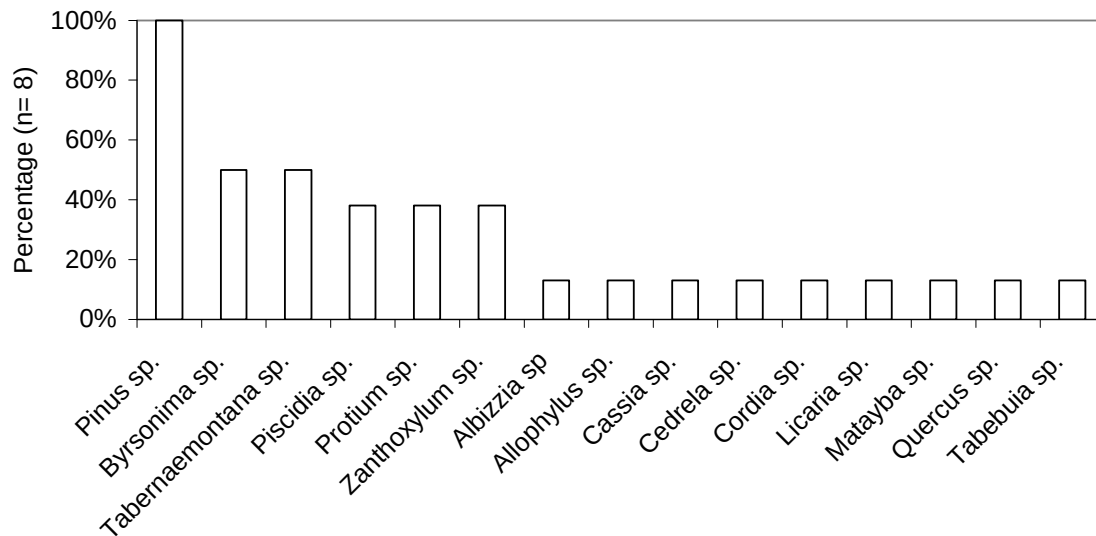


Figure 5.6: Distribution of charcoal genera measured by ubiquity

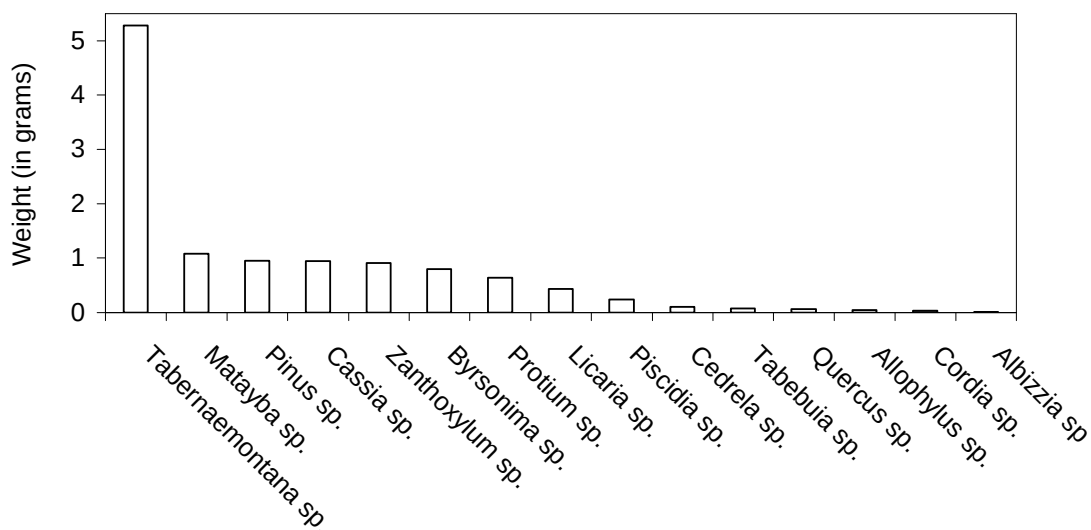


Figure 5.7: Distribution of charcoal genera measured by weight

Classic (Reiko Ishihara, personal communication 2001). Radiometric analysis of charcoal from Unit 12, Level 3 yielded a date of  $1240 \pm 70$  BP (Cal. A.D. 660-970, 2 sigma range) (Beta-164695), supporting a Late Classic time frame for Unit 12. In sum, chronological comparisons in the archaeobotanical assemblage from Chamber 3B can be made with Unit 10 representing the Early Classic period and Unit 12 representing the Late Classic period.

**Wood charcoal.** Carbonized wood is the dominant type of macroflora recovered from Actun Chapat. The relative importance of hardwood and pine charcoal was measured by ubiquity and weight. Both pine and hardwood charcoal are present in 100% of sampled deposits. Comparing the weights between these groups from one-liter flotation samples shows that ubiquity analysis inflates pine's contribution to the charcoal assemblage (Figure 5.4). Two

one-liter flotation samples were collected from Unit 11, Level 6. These data were halved in order to standardize them with the single one-liter samples from the remaining deposits. Also, no flotation sample is available for Level 2 of Unit 10. Thus, this deposit is not included in this weight comparison. A total of 13.58 g of hardwood charcoal were recovered versus 0.51 g of pine. If the total charcoal data are added, including charcoal from macrofossil samples, then the disparity between hardwoods and pine is increased (29.48 g of hardwood charcoal versus 0.95 g of pine). Consequently, while ubiquity demonstrates regularity in pine's distribution, weight measurements indicate that its overall contribution is substantially less than hardwood charcoal.

In addition to pine, a number of hardwood charcoal specimens were identified to the family, and many were identified to genus (Table 5.1, Figures 5.5). Hardwood

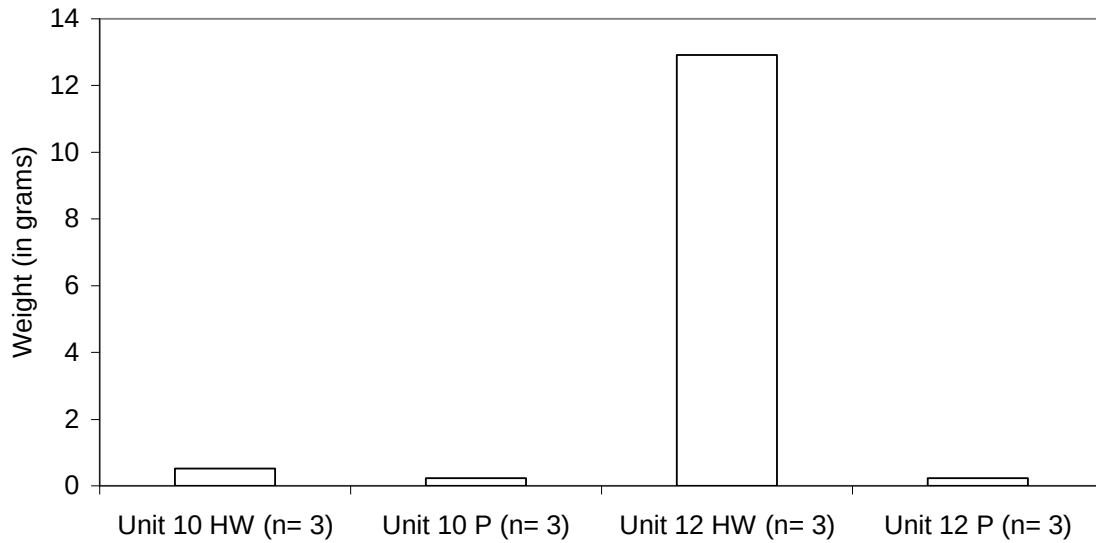


Figure 5.8: Distribution of hardwood and pine charcoal between Unit 10 and Unit 12 measured by weight. HW= hardwood, P= pine.

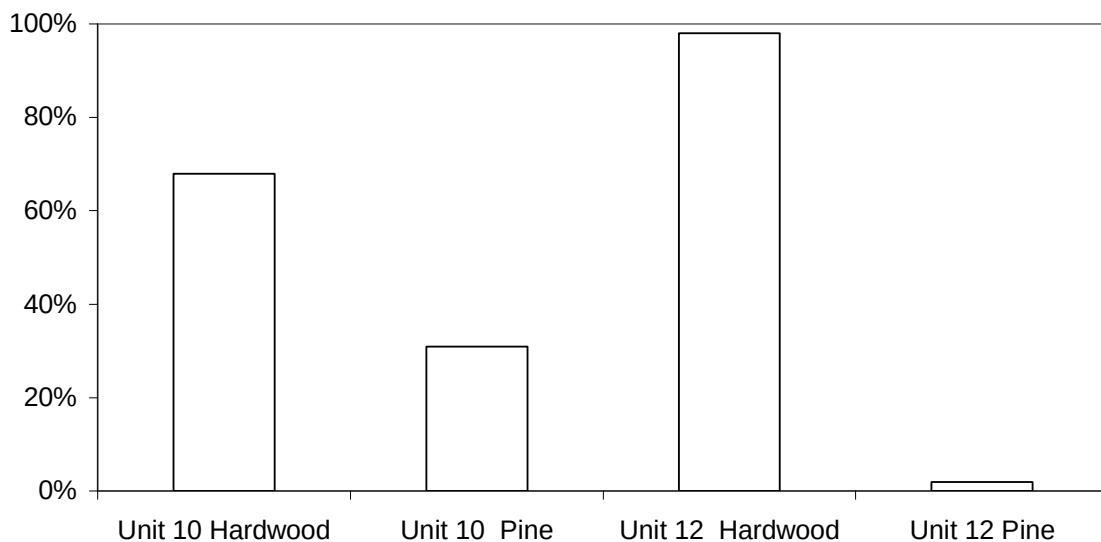


Figure 5.9: Proportion of pine and hardwood charcoal between Unit 10 and Unit 12.

genera identified include *Byrsonima* sp., *Cedrela* sp., *Piscidia* sp., *Protium* sp., *Albizia* sp., *Quercus* sp., *Tabebuia* sp., *Allophylus* sp., *Tabernaemontana* sp., *Cordia* sp., *Zanthoxylum* sp., *Cassia* sp., *Licaria* sp., and *Matayba* sp. The distribution of individual genera was examined through ubiquity analysis and weight measurements. The ubiquity measurement shows that pine is the most widely distributed wood charcoal (100%) (Figure 5.6). *Byrsonima* sp. and *Tabernaemontana* sp. both appear in 50% of sampled deposits followed by *Piscidia* sp., *Protium* sp., and *Zanthoxylum* sp. (38%). The remaining genera were each recovered from only one deposit (13%).

A different pattern emerges when weights are compared by genera. Because some genera are only represented in macrofossil samples, the total charcoal weight is used for

comparison. Figure 5.7 demonstrates that *Tabernaemontana* sp. is the dominant wood charcoal by weight (5.28 g). *Matayba* sp. is the second most abundant charcoal (1.08 g), followed by pine (0.95 g), *Cassia* sp. (0.94 g), *Zanthoxylum* sp. (0.91 g), *Byrsonima* sp. (0.8 g), and *Protium* sp. (0.64 g). The remaining genera are each represented by under 0.5 grams of charcoal. Specimens only identified as hardwoods or only to the family are not included. If identification of these specimens were possible, the representation of individual genera would be increased. For example, some specimens that are listed as Burseraceae may actually be a species of *Protium* (Table 5.1). If so, *Protium*'s contribution to the charcoal assemblage would be greater than shown in Figure 5.7. The same caution should be considered when evaluating genera from the Leguminosae family.

Table 5.2: List of charcoal genera per unit. Present (+) or absent (-).

| Genera                     | Unit 10 | Unit 11 | Unit 12 |
|----------------------------|---------|---------|---------|
| <i>Albizzia</i> sp.        | +       | -       | -       |
| <i>Allophylus</i> sp.      | +       | -       | -       |
| <i>Byrsonima</i> sp.       | +       | +       | +       |
| <i>Cassia</i> sp.          | -       | -       | +       |
| <i>Cedrela</i> sp.         | +       | -       | -       |
| <i>Cordia</i> sp.          | -       | +       | -       |
| <i>Licaria</i> sp.         | -       | -       | +       |
| <i>Matayba</i> sp.         | -       | -       | +       |
| <i>Pinus</i> sp.           | +       | +       | +       |
| <i>Piscidia</i> sp.        | +       | +       | +       |
| <i>Protium</i> sp.         | +       | -       | +       |
| <i>Quercus</i> sp.         | +       | -       | -       |
| <i>Tabebuia</i> sp.        | +       | -       | -       |
| <i>Tabernaemontana</i> sp. | -       | +       | +       |
| <i>Zanthoxylum</i> sp.     | -       | +       | +       |

By comparing both weight and ubiquity values a better picture of the charcoal assemblage emerges than with each type alone. Each method provides a check on the other. For instance, while ubiquity emphasizes the prominent distribution of pine, weight measurements show that much less pine was burned than other taxa. On the other hand, weight measurements inflate the overall representation of certain taxa with low ubiquity values. For example, *Matayba* sp. is the second dominant genus when wood charcoal is calculated by weight. Its appearance in the archaeobotanical collection, however, is limited to only one deposit. Consequently, although a substantial amount of *Matayba* sp. wood was burned, the burning of *Matayba* sp. was spatially and temporally restricted. The correspondence between the weight and ubiquity of other genera, such as *Tabernaemontana* sp., is better. *Tabernaemontana*'s occurrence is more frequent than most other taxa, and it is the dominant wood charcoal by weight.

The patterns discussed above are focused on the overall charcoal assemblage. Because Units 10 and 12 are temporally distinct, chronological comparisons are possible. Figure 5.8 shows the differences in the weight of pine and hardwood charcoal between the Early Classic (or earlier) deposits of Unit 10 and the Late Classic period deposits of Unit 12 from one-liter flotation samples. A total of 0.53 g of hardwood charcoal and 0.24 g of pine were recovered from Unit 10 versus 12.92 g of hardwood charcoal and 0.24 g of pine from Unit 12. This pattern indicates that a substantially greater amount of hardwoods were burned in the area tested by Unit 12, suggesting an increase in burning activity during the Late Classic period.

Another pattern involves the weight of pine between Unit 10 and Unit 12 (Figure 5.9). Both units yielded 0.24 g of

pine. Although this data may suggest that the utilization of pine remained constant, its use changed proportionately. For instance, the total weight of charcoal from flotation samples from Unit 10 (including 0.01 g of an unknown dicot not included in Figure 5.8) is 0.78 g. Pine comprises 31% of Unit 10's charcoal assemblage. Conversely, the proportion of pine from Unit 12 is reduced. Only 2%, or 0.24 g out of a total 13.16 g, of Unit 12's total charcoal is pine. Pine continued to be burned during the Late Classic period, but proportionately more hardwoods were burned than pine.

Examination of individual genera shows that a number of taxa occur in both Unit 10 and Unit 12, suggesting that these woods continued to be used from at least the Early Classic period to the Late Classic period (Table 5.2). Forty-four percent of charcoal genera from Unit 10 (n= 9) were found in Unit 12. Likewise, 44% of genera from Unit 12 (n=9) were recovered from Unit 10. Thus, in terms of the overall number of individual wood taxa from both units (n= 14), 29% are found in both (*Pinus* sp., *Piscidia* sp., *Protium* sp., and *Byrsonima* sp.).

The charcoal remains from Unit 11, which are of unknown date, have a stronger relationship to Unit 12 than to Unit 10. Fifty percent of wood genera from Unit 11 (n= 6) occur in both units 10 and 12, specifically *Pinus* sp., *Piscidia* sp., and *Byrsonima* sp.. An additional 33%, *Tabernaemontana* sp. and *Zanthoxylum* sp., of Unit 11's charcoal assemblage are found in Unit 12 but not in Unit 10. Thus, 83% of Unit 11's charcoal taxa are represented in Unit 12. This examination of Unit 11's charcoal content demonstrates closer affinities with Unit 12 than Unit 10 based on the present data, suggesting that the area tested by Unit 11 may be chronologically coeval with Unit 12.

Finally, some charcoal specimens from Actun Chapat are from either young stems or from branches. Table 5.3 lists the weight of charcoal from young stems in each deposit sampled for flotation. Because two flotation samples were recovered from Unit 11, Level 6, these data were halved. Young stems or branches are represented solely by hardwood charcoal. No pine specimens appeared to be from young stems, although this fact may be the result of differential preservation. Preservation limited determinations of maturity for some hardwood specimens as well. Thus, the weight of immature stems or branches may actually be greater than shown in Table 5.3. The only flotation sample from Unit 10, Level 6, contained pine alone, although the macrofossil sample from Level 6 yielded hardwoods (Table 5.1).

The proportion of young stems or branches in the charcoal assemblage is relatively constant. At first glance, it appears that Unit 12 included more immature remains. This disparity is due to the differential proportion of pine discussed above. When pine is removed from consideration, the even proportion of young stems or branches throughout all deposits is clear. This pattern suggests that young stems or branches were the preferred

Table 5.3: Contribution of young stems or branches in the charcoal assemblage.

| Provenience        | Immature | Total | % Immature | % Immature w/o pine |
|--------------------|----------|-------|------------|---------------------|
| CH3B, T20, U10, L3 | 0.34     | 0.43  | 79%        | 97%                 |
| CH3B, T20, U10, L4 | 0.19     | 0.29  | 66%        | 100%                |
| CH3B, T20, U10, L6 | 0        | 0.06  | 0%         | -                   |
| CH3B, T26, U11, L6 | 0.13     | 0.16  | 81%        | 100%                |
| CH 3B, U12, L3     | 7.08     | 7.59  | 93%        | 96%                 |
| CH 3B, U12ext, L3  | 0.48     | 0.58  | 83%        | 87%                 |
| CH 3B, U12, L4     | 4.77     | 4.99  | 96%        | 96%                 |

form of wood used in Actun Chapat.

**Domesticated Plants.** Maize (*Zea mays*), beans (*Phaseolus* sp.), and squash (*Cucurbita* sp.) are represented in flotation samples (Table 5.1). One fragmented bean was recovered from Unit 11, Level 6. Due to poor preservation, it was not possible to discern its species. Squash remains consist only of carbonized rinds from Unit 10, Level 4. Identification beyond genus was impossible because there are substantial similarities in rind morphology between different species of *Cucurbita*. Maize remains are the dominant domesticated cultigen in the archaeobotanical assemblage. All undisturbed deposits sampled through flotation yielded maize (Table 5.1). Maize remains consist of individual cupules, glumes, kernels, and one larger cob fragment (Figure 5.10). No complete cobs were found. Since many parts of the maize ear are present, the maize appears to have been relatively unprocessed, and fragmentation is due to burning and decomposition over time.

Morphological attributes of the maize were measured (Table 5.4). Parts of the maize ear are represented differentially and preservation varies. Measurements made on some specimens may not have been possible on others. With the exception of one kernel from Unit 12, Level 3, all maize specimens that were measured are from levels 3 and 4 of Unit 10. Maize remains from other deposits and units were too fragmentary for

morphological analysis. Thus, maize measurements listed in Table 5.4 do not account for all the maize in Table 5.1.

Measurements of cupule width, cupule length, and cupule wing width were possible on five specimens from Unit 10, Level 3, and on seven specimens from Unit 10, Level 4. From Unit 10, Level 3, three additional specimens were preserved well enough to allow cupule length measurements, and cupule wing width was recorded for another. Two cupules and one cob fragment from Unit 10, Level 4, had attached glumes, allowing glume width to be recorded. The three specimens with glume width measurements from Level 3 are from individual glumes rather than glumes attached to cupules. Cupule angle was recorded for two cupules and one cob fragment from Level 4. Cupules from Level 3 were too fragmentary for cupule angle measurements. Finally, the only kernel that was complete enough for measurements was recovered from Unit 12, Level 3. The kernel's length, width, and angle were recorded. Because the overall maize sample is small and composed only of fragments, observable patterns in the assemblage should be evaluated cautiously.

Maize specimens from Unit 10, Level 3, are larger than maize from Unit 10, Level 4. The average, uncorrected cupule width from Level 3 is 3.86 mm versus 2.5 for Level 4. Maize from Level 3 also has wider cupule wings and glumes than those from Level 4. The average, uncorrected cupule wing and glume widths from Level 3 are 1.56 mm and 2.37 mm, respectively, whereas cupule wing width and glume width for Level 4's maize are 0.77 mm and 1.17 mm. Cupule length, however, is similar for maize from both levels, though cupules from Level 3 are longer (1.79 mm versus 1.61 mm).

Specimens from Unit 10, Level 3, have longer, flared cupule wings that are substantially more prominent than those from Level 4 (Figure 5.11). By analyzing the relationship between the cupule widths and cupule wing widths of individual specimens from levels 3 and 4, three separate clusters emerge (Figure 5.12). Two tightly clustered groups are present in Level 4. One group is present in Level 3. The group from Level 3 is loosely clustered compared to those of Unit 10, Level 4, indicating greater variation in cupule wing width and cupule width.



Figure 5.10: Maize (*Zea mays*) cob fragment from Actun Chapat (20049-008). Marks indicate 1 mm.

Table 5.4: Morphological measurements of maize from Actun Chapat. Metric measurements are in millimeters.

| Provenience        | ID Number | Maize Part            | Cupule Width | Cupule Wing   | Cupule Length | Cupule Angle | Glume Width | Row Number |
|--------------------|-----------|-----------------------|--------------|---------------|---------------|--------------|-------------|------------|
| CH3B, T20, U10, L3 | 20048     | Cupule A              | 4.6          | 2             | 2.1           | -            | -           | -          |
|                    |           | Cupule B              | 3.9          | 1.4           | 2.5           | -            | -           | -          |
|                    |           | Cupule C              | 3.7          | 1.5           | 2             | -            | -           | -          |
|                    |           | Cupule D              | 3.3          | 1.2           | 1.6           | -            | -           | -          |
|                    |           | Cupule E              | 3.8          | 1.6           | 1.8           | -            | -           | -          |
|                    |           | Cupule F              | -            | -             | 1.4           | -            | -           | -          |
|                    |           | Cupule G              | -            | -             | 1.5           | -            | -           | -          |
|                    |           | Cupule H              | -            | -             | 1.4           | -            | -           | -          |
|                    |           | Cupule I              | -            | 1.8           | -             | -            | -           | -          |
|                    |           | Glumes A              | -            | -             | -             | -            | 2.4         | -          |
|                    |           | Glumes B              | -            | -             | -             | -            | 2.6         | -          |
|                    |           | Glumes C              | -            | -             | -             | -            | 2.1         | -          |
|                    |           | <b>Mean</b>           | 3.86         | 1.59          | 1.79          | -            | 2.37        | -          |
|                    |           | <b>20% Correction</b> | 4.63         | 1.91          | 2.15          | -            | 2.84        | -          |
| CH3B, T20, U10, L4 | 20049     | Cupule A              | 1.9          | 1             | 1.7           | -            | -           | -          |
|                    |           | Cupule B              | 2            | 1.2           | 1.7           | -            | -           | -          |
|                    |           | Cupule C              | 1.6          | 0.9           | 1.4           | -            | -           | -          |
|                    |           | Cupule D              | 2.9          | 0.5           | 1.4           | -            | -           | -          |
|                    |           | Cupule E              | 3.3          | 0.6           | 2             | 74°          | 1.3         | 10         |
|                    |           | Cupule F              | 2.8          | 0.6           | 1.7           | 72°          | 1           | 10         |
|                    |           | Cob frag. A           | 3            | 0.6           | 1.4           | 73°          | 1.2         | 10         |
|                    |           | <b>Mean</b>           | 2.5          | 0.77          | 1.61          | 73°          | 1.17        | 10         |
|                    |           | <b>20% Correction</b> | 3            | 0.92          | 1.93          | -            | 1.4         | -          |
| Provenience        | ID Number | Maize Part            | Kernel Width | Kernel Length | Kernel Angle  | Row Number   |             |            |
| CH3B, U12, L3      | 20058     | Kernel A              | 5.7          | 6.3           | 52°           | 8 ?          |             |            |
|                    |           | <b>20% Correction</b> | 6.84         | 7.56          | -             | -            |             |            |

Comparisons of cupule width and cupule length of the same specimens indicate greater overlap than shown in Figure 5.12 (Figure 5.13). One group consists of specimens from both Levels 3 and 4 of Unit 10. There is substantial variation in this group, however, and specimens from Level 3 tend to be more closely related.

On the other hand, one grouping shown in Figure 5.12 remains intact in Figure 5.13, suggesting that it represents a distinct group. This group is composed of cupules A-C of Unit 10, Level 4.

There are a number of possible explanations for these groupings. Three taxonomically different maize types may be present in the assemblage. Alternatively, one or more similar types were deposited, each at different levels of maturity. Or, one or more similar types may have been deposited, but the maize assemblage reflects remains from different areas of the cob. For instance, the cob fragment from Unit 10, Level 4, is distinctly tapered, suggesting that it is from the distal end of a cob (Figure 5.10). Qualitatively, it seems that the individuals from Unit 10, Level 3 do form a separate group due to the prominence of the cupule wings, a morphological attribute that is lacking in specimens from Unit 10, Level

4. Unfortunately, the small sample size of Actun Chapat's maize prevents extensive quantitative testing of these groups.

Cupule and kernel angles are useful measurements. Angle measurements allow row number to be estimated by taking into account the fact that each cupule and each kernel composes a portion of the total 360° angle formed by the cob (Bird 1994:18; Cutler and Blake 2001:95 [1976]); Pearsall 1980:345). Cupule angle was recorded for three specimens from Unit 10, Level 4. The average cupule angle for the three specimens is 73°. The ideal cupule angle for ten-rowed maize is 72°. The variation from the ideal angle in Level 4's specimens is minimal, indicating that they are the remnants of a ten-rowed ear of maize.

Kernel angle was measured for one specimen from Unit 12, Level 3. The single kernel is not dented with a width of 5.7 mm and a length of 6.3 mm. Kernel thickness was not recorded. The kernel's angle is 52°. This value is not useful in approximating row number. Kernel angles of 45° and 60° are ideal values for eight and six rows, respectively. Carbonization likely distorted Unit 12's





Figure 5.11: Close up of cupule fragment from Actun Chapat displaying prominent cupule wings (20048-006). Marks indicate 1 mm.

kernel angle. Although carbonization shrinks maize remains, heat may have caused the kernel to expand along angular planes (King 1994:37). If so, the ideal angle for Unit 12's kernel may be closer to 45°, indicating an eight-rowed maize.

If the conclusions drawn from Unit 10 and Unit 12's angle measurements are valid, the maize from these units may have had distinct row numbers. This pattern might suggest that different maize types were used during the earlier deposits of Unit 10 than during the later deposits of Unit 12. Overall, the sample available for angle measurements is small. Numerous scholars have discussed difficulties in using angle measurements from small samples to estimate row numbers (see King 1994:38; Pearsall 1980:347, 350). Due to variation and overlap within and between maize types, small samples are insufficient to characterize a population of specimens. Although the angle measurements from Actun Chapat's maize are helpful in suggesting different row numbers between remains from Unit 10 and Unit 12, substantially more data are needed to confirm this pattern.

Comparing Actun Chapat's maize with other archaeological specimens from the Maya region is difficult because internal cob characteristics, such as cupule measurements, are rarely recorded. Information on cupule width and cupule wing width from Cuello, located in northern Belize, shows morphological and developmental patterns similar to Actun Chapat's maize (Figure 5.14) (Miksicek et al. 1981) (Appendix C). The

cupules from Cuello span the Middle to Late Formative period from the Swasey Phase through the Mamom Phase to the Chicanel Phase (ca. 1100 B.C. to A.D. 250). The size increase of Actun Chapat's cupules from Unit 10, Level 4 to Level 3, is similar to developmental trends observed at Cuello. Cupule measurements for Cuello's Swasey Types 1 and 2 fall between the two morphological groupings observable from Unit 10, Level 4. Swasey Type 3 and Chicanel Type 1, however, are morphologically closer to specimens from Unit 10, Level 3. Based on cupule width and cupule wing width, Cuello's Mamom maize types display the least affinity to specimens from Actun Chapat.

Maize from Cuello was also compared to Actun Chapat's assemblage using cupule length instead of cupule wing width (Figure 5.15). Again, there are similar morphological relationships between Actun Chapat and Cuello. In this second comparison, however, Actun Chapat maize specimens from Unit 10, Level 3 have more affinities with Cuello's Mamom Type 1 maize than to Chicanel Type 1.

Despite the variation in using cupule length versus cupule wing width in bi-variate analyses, Actun Chapat's maize remains appear similar both morphologically and developmentally to Formative period maize from Cuello overall. Actun Chapat's maize specimens have affinities to maize from other Formative period, lowland Mesoamerican sites. The average, uncorrected cupule width of Actun Chapat's maize from Unit 10, Level 4, is 2.5 mm, the same width as cupules recovered from La Venta, an Olmec site in the Gulf Coast region of Mexico (Rust and Leyden 1994:196).

Corrected cupule measurements from Actun Chapat were compared to modern Mexican races of maize (Appendix C). Cupule measurements from the author's Nal Tel and from Nal Tel, Chapalote, Dzit Bacal, and Arrocillo described by Benz (1986) were compared to Actun Chapat's maize. Metric data from Wellhausen et al (1952) are not included because only external cob measurements are available.

As shown in Figure 5.16, there is little correspondence between the archaeological maize and the modern races even when the 20% correction is made. With the exception of cupule wings from Unit 10, Level 3, which are prominently flared, cupules from Actun Chapat are smaller than modern taxa. The closest morphological relationship is between specimens from Unit 10, Level 4, and Arrocillo. On the other hand, Level 4's maize has an estimated row number of ten, within the range of row numbers recorded for the lowland maize varieties (Appendix B). Arrocillo's recorded row numbers are much higher, ranging between 12 and 22 (Benz 1986:341).

The dissimilarity between archaeological and modern maize is possibly the result of Actun Chapat's small



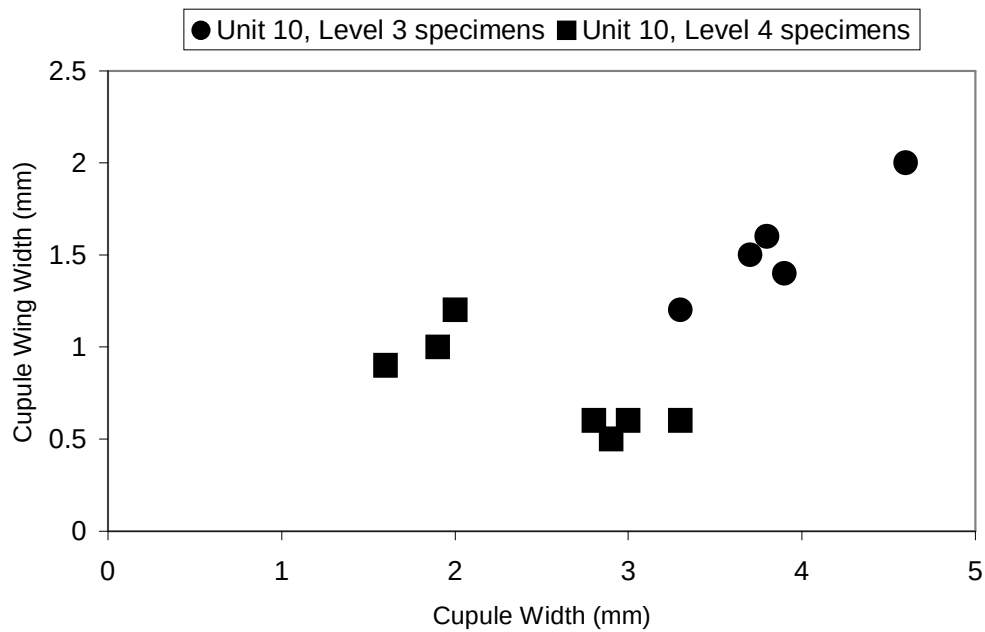


Figure 5.12: Differences in maize from Unit 10 measured by uncorrected cupule width and cupule wing width (n= 12).

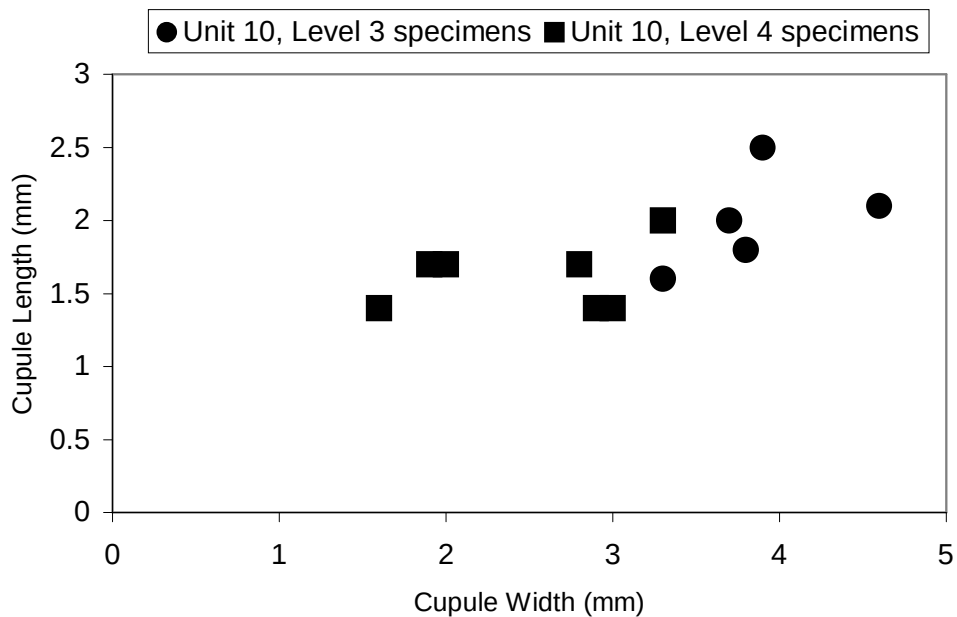


Figure 5.13: Differences in maize from Unit 10 measured by uncorrected cupule width and cupule length (n= 12).

sample size. Conversely, this pattern could reflect immaturity if the cobs are from underdeveloped maize ears. Immaturity may also explain the similarity between Actun Chapat's maize and the Formative period maize from Cuello. On the other hand, immaturity does not explain the structurally parallel developmental trend in maize from both Cuello and Actun Chapat. Overall, it is not surprising that the maize from Actun Chapat, dating to at least the Early Classic period and possibly earlier, shows greater affinity to maize from a similar time period than to modern maize. No cob measurements were

possible on maize from the Late Classic period deposits of Unit 12. Consequently, broad chronological patterns in Actun Chapat's maize are not observable.

**Other Macrofloral Remains.** Other remains collected from Actun Chapat consist of material that could not be identified (Table 5.1). Two dicot floral buds were recovered, one from Unit 10, Level 3 and one from Unit 12-ext, Level 3. Two unknown disseminules were found in Unit 10, Level 3, and one larger seed was retrieved from Unit 10, Level 4. Although these archaeobotanical

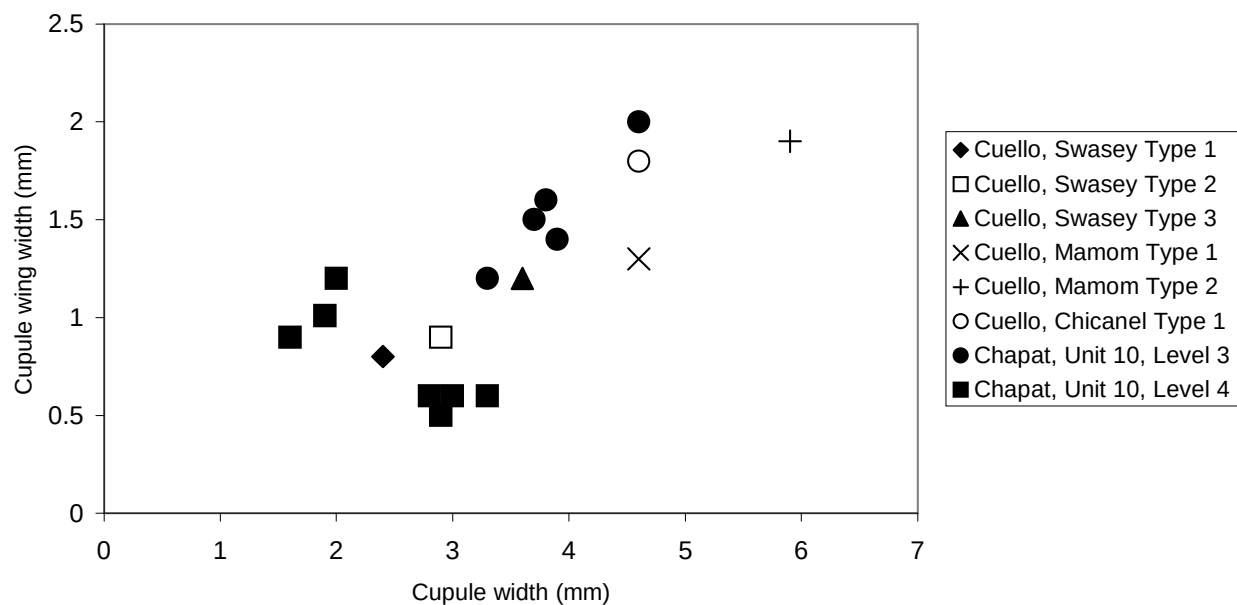


Figure 5.14: Comparison between maize from Actun Chapat and Cuello based on uncorrected cupule width and cupule wing width.

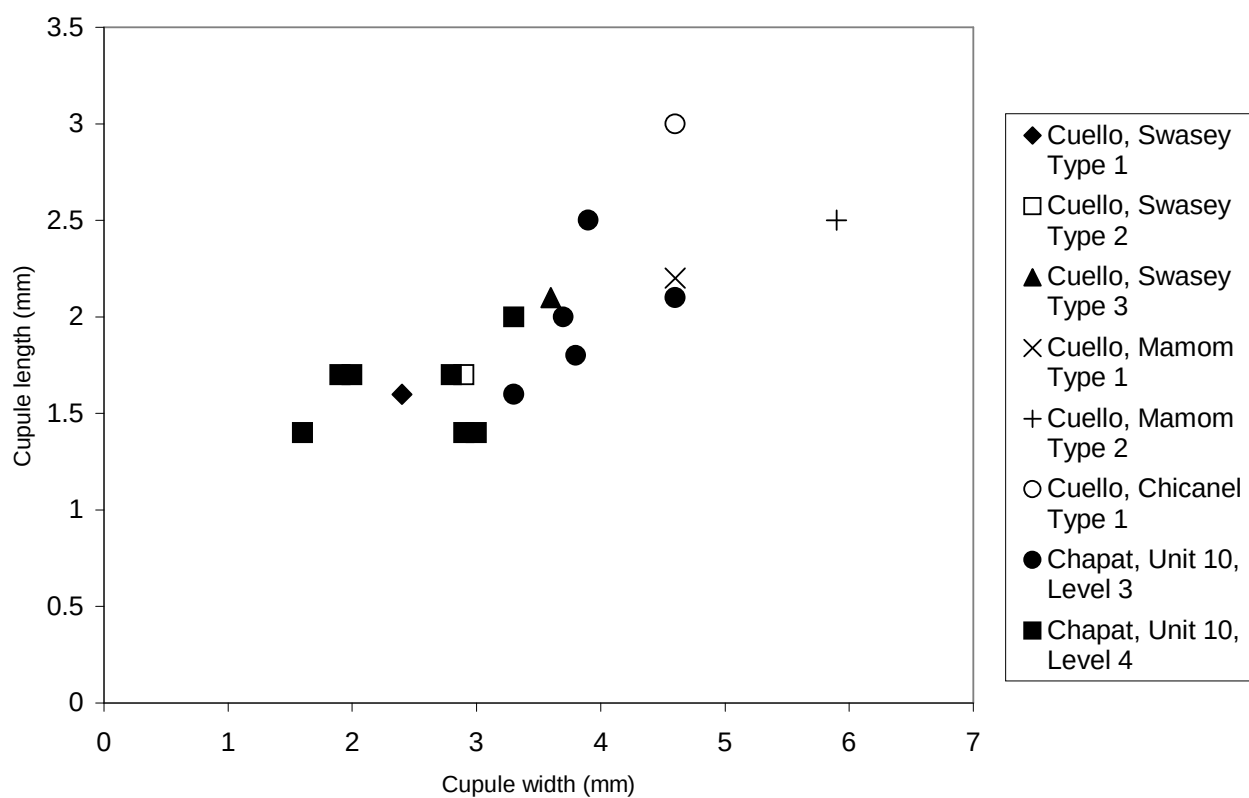


Figure 5.15: Comparison between maize from Actun Chapat and Cuello based on uncorrected cupule width and cupule length.

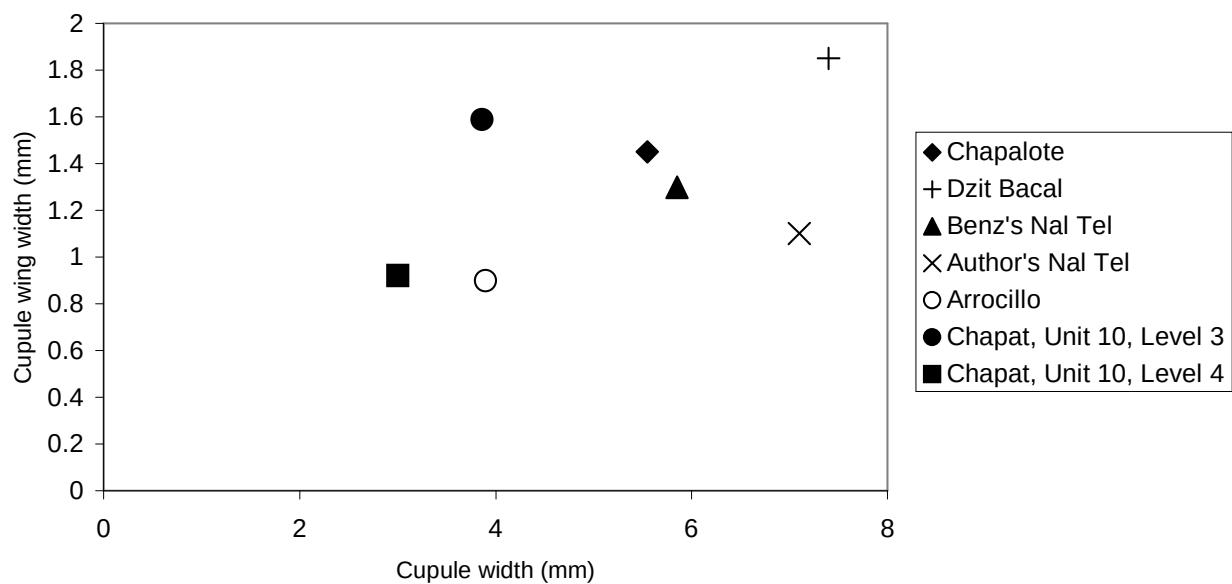


Figure 5.16: Comparison between Actun Chapat and modern maize based on cupule width and cupule wing width.

remains are charred, their taxonomic identities and archaeological significance are unknown.

#### *Actun Halal*

Both flotation and macrofossil samples were collected from Actun Halal. Eleven one-liter flotation samples were retrieved from 11 deposits, and seven macrofossil samples were recovered from seven deposits. Sixteen archaeological deposits are represented in the archaeobotanical assemblage (Appendix A). One deposit (Unit 6, Level 2) was devoid of any botanical remains. Results are presented in Table 5.5.

The disturbed conditions of Actun Halal's archaeological deposits discussed in the previous chapter are especially problematic in evaluating the content of Actun Halal's archaeobotanical assemblage. The disturbances pose difficulties in determining whether remains are natural or cultural. Some carbonized remains may reflect off-site burning that washed into the cave. Other charred material naturally deposited prior to prehistoric activity may have been burned with culturally deposited botanicals. If some remains are cultural, their primary contexts are uncertain. Thus, ubiquity analysis and weight measurements are tentative, and possibly questionable.

Chronological patterns in the archaeobotanical assemblage cannot be determined with confidence. Ceramic remains suggest that Actun Halal was predominantly used during the Late Classic period (Ishihara 2001a). Although ceramic data at Actun Halal are useful for proposing the overall temporal use of the cave, they are insufficient for dating individual archaeological deposits due to stratigraphic mixing. While it is likely that most of the cultural archaeobotanical remains were deposited during the Late Classic period, it would be misleading to discuss specific

chronological trends in the assemblage. Due to erosion, spatial analysis of botanical material is impractical.

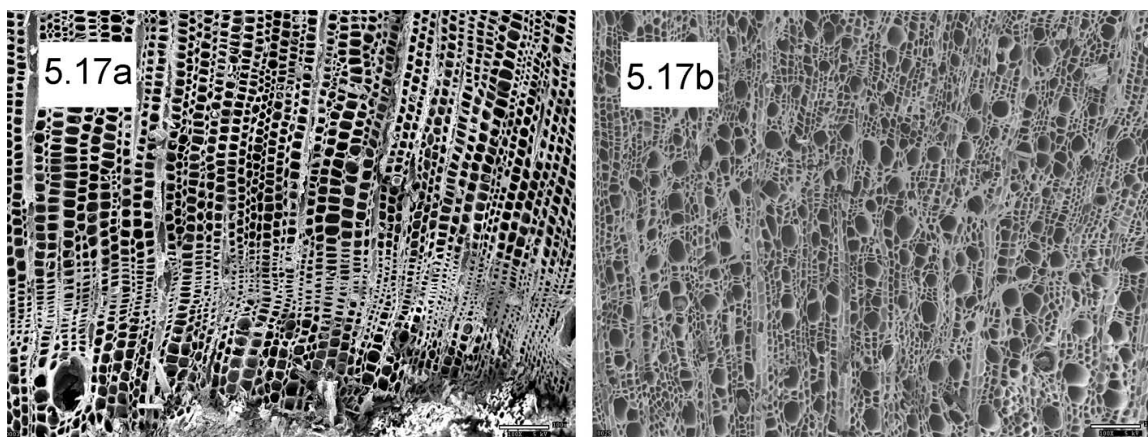
**Wood Charcoal.** Carbonized wood is the dominant type of archaeobotanical remains recovered from Actun Halal (Figure 5.17). Compared to other cave sites, identification of Actun Halal's charcoal specimens was often possible only to the family level. This limitation was due to the poor preservation of Actun Halal's charcoal collection. More specific identifications were possible for several genera, including pine, *Pouteria* sp., *Ficus* sp., *Aspidosperma* sp., and *Lonchocarpus* sp. A tentative identification of c.f. *Licania arborea* was also made. Pine charcoal was the most ubiquitous botanical genera. Sixty-three percent of sampled deposits contained pine charcoal ( $n = 16$ ). The remaining genera were found in only one deposit each (6%). When the ubiquity of all hardwood charcoal is compared to pine hardwoods dominate the assemblage (Figure 5.18). Seventy-five percent of deposits yielded hardwood charcoal. Weight measurements of charcoal from one-liter flotation samples also demonstrate that hardwoods compose the majority of the charcoal collection (Figure 5.19). Hardwoods are represented by 0.81 g of charcoal versus 0.35 g of pine. As previously discussed, these ubiquity and weight comparisons may not accurately reflect patterns of prehistoric deposition due to destructive taphonomic processes.

**Other Macrofloral Remains.** Other botanical remains are represented in the archaeobotanical assemblage from Actun Halal. Endocarps, or nut shells, and fruit pits were recovered. Some endocarp specimens are from palms (Arecaceae). Other endocarps and pits are morphologically similar to fruits from the Verbenaceae family, possibly a species of *Vitex*. These materials are probably natural because the same types of fruits are littered throughout the surface of the cave. Uncarbonized

Table 5.5: Archaeobotanical remains from Actun Halal, Cayo District, Belize. E= entrance, U= unit, L= level, F= feature, NE= northeast section of unit, \*= uncarbonized, – = unquantified.

| Provenience    | Scientific Name                                                                                             | Part                                                                              | Weight                                               | #                               | ID Number    |
|----------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------|--------------|
| E2, U1, L1     | <i>Pinus</i> sp.<br>Hardwood<br>Hardwood<br>Arecaceae                                                       | Charcoal<br>Charcoal<br>Charcoal<br>Endocarp                                      | 0.03<br>> 0.01<br>> 0.01<br>0.02                     | -<br>-<br>-<br>-                | 20025        |
| E2, U1, L2     | Dicot*<br>Verbenaceae*<br><i>Pinus</i> sp.<br>Dicot<br>Araliaceae<br>Hardwood                               | Rootlets<br>Fruit pit<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal             | 0.08<br>0.21<br>0.02<br>0.01<br>0.01<br>0.01         | -<br>1<br>-<br>-<br>-<br>-      | 20026        |
| E2, U1, L3     | Dicot*<br><i>Pinus</i> sp.<br>Sapotaceae                                                                    | Rootlets<br>Charcoal<br>Charcoal                                                  | 0.21<br>0.09<br>> 0.01                               | -<br>-<br>-                     | 20027        |
| E2, U1, L4     | <i>Pinus</i> sp.<br>Araliaceae                                                                              | Charcoal<br>Charcoal                                                              | > 0.01<br>0.01                                       | -<br>-                          | 20028        |
| E2, U1, L5B    | Araliaceae<br><i>Pouteria</i> sp.                                                                           | Charcoal<br>Charcoal                                                              | 0.37<br>> 0.01                                       | -<br>-                          | 20029        |
| E2, U1, L 7    | Hardwood                                                                                                    | Charcoal                                                                          | 0.09                                                 | -                               | 10001        |
| E1, U2, L2     | <i>Pinus</i> sp.<br>cf. <i>Licania arborea</i><br>Verbenaceae<br>Hardwood                                   | Charcoal<br>Charcoal<br>Endocarp<br>Charcoal                                      | 0.02<br>0.2<br>0.32<br>0.07                          | -<br>-<br>-<br>-                | 10002, 20030 |
| E1, U2, L2, NE | <i>Pinus</i> sp.<br>Arecaceae<br>Hardwood<br>Combretaceae                                                   | Charcoal<br>Endocarp<br>Charcoal<br>Charcoal                                      | 0.05<br>0.01<br>0.04<br>0.01                         | -<br>-<br>-<br>-                | 20031        |
| E1, U3, L1     | <i>Pinus</i> sp.                                                                                            | Charcoal                                                                          | 0.07                                                 | -                               | 10003        |
| E1, U3, L2     | <i>Pinus</i> sp.<br>Leguminosae<br>Dicot<br>Lauraceae<br><i>Ficus</i> sp.<br>Verbenaceae<br>Hardwood        | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Endocarps<br>Charcoal | 1.57<br>0.04<br>6.03<br>0.13<br>0.05<br>2.86<br>0.33 | -<br>-<br>-<br>-<br>-<br>-<br>- | 10004, 20032 |
| E1, U3, L2, F1 | Dicot                                                                                                       | Roots                                                                             | 3.31                                                 | -                               | 10005        |
| E1, U3, L3     | <i>Pinus</i> sp.<br>Verbenaceae                                                                             | Charcoal<br>Fruit Pit                                                             | 1.43<br>0.67                                         | -<br>1                          | 10006        |
|                | Dicot                                                                                                       | Charcoal                                                                          | 0.1                                                  | -                               |              |
|                | Rubiaceae<br>Leguminosae<br><i>Aspidosperma</i> sp.<br>Araliaceae<br>Verbenaceae<br><i>Lonchocarpus</i> sp. | Charcoal<br>Charcoal<br>Charcoal<br>Charcoal<br>Endocarp<br>Charcoal              | 0.1<br>0.21<br>0.29<br>0.81<br>0.18<br>0.01          | -<br>-<br>-<br>-<br>-<br>-      |              |

| Table 5.5, cont'd                   |                                  |                          |                    |             |           |
|-------------------------------------|----------------------------------|--------------------------|--------------------|-------------|-----------|
| Provenience<br>E1, U3, L3<br>cont'd | Scientific Name                  | Part                     | Weight             | #           | ID Number |
|                                     | Leguminosae<br>Poaceae           | Cotyledon<br>Caryopsis   | > 0.01<br>> 0.01   | 1<br>1      |           |
| E2, U4, L6                          | Verbenaceae*<br>Dicot*<br>Dicot* | Endocarp<br>Root<br>Rind | 1.08<br>0.3<br>0.1 | -<br>-<br>- | 10007     |
| E1, U6, L1                          | Compositae<br>Hardwood           | Achene<br>Charcoal       | > 0.01<br>0.08     | 1<br>-      | 20033     |
| E1, U6, L2                          | Sterile                          | -                        | -                  | -           | 20035     |
|                                     |                                  |                          |                    |             |           |



Figures 5.17: Wood charcoal from Actun Halal. 5.17a: *Pinus* sp. charcoal X100 (10003-001). 5.17b: *Aspidosperma* sp. charcoal X100 (10006-009).

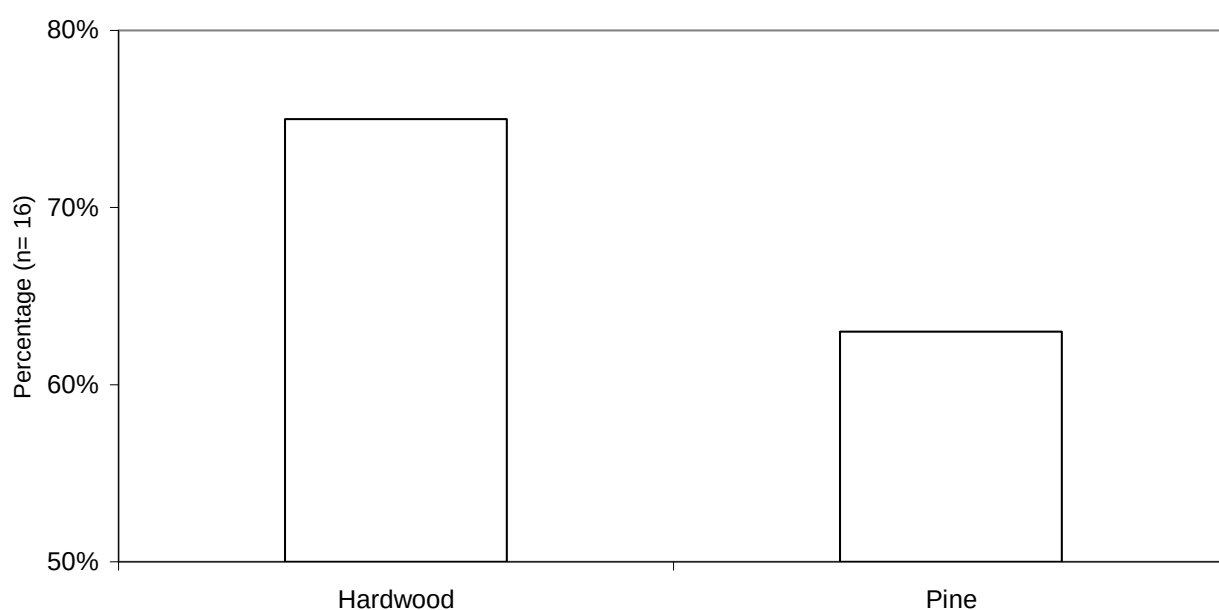


Figure 5.18: Differences in the distribution of hardwood and pine charcoal measured by ubiquity.



Figure 5.19: Differences in hardwood and pine charcoal measured by weight from flotation samples.

Verbenaceae endocarps from Unit 4, Level 6, are likely intrusive (Table 5.5). Charred examples of these taxa are probably due to the fact that their present littered distribution in the cave was similar in the past. Thus, they were burned with culturally deposited materials in antiquity.

Other botanical remains consist of carbonized and uncarbonized roots and three carbonized seed remains, including a Compositae achene, a Leguminosae cotyledon, and a grass caryopsis (Poaceae). The roots are intrusive. The archaeological significance of the seed remains is uncertain. In light of the disturbed contexts of remains at Actun Halal, the small size and limited distribution of the seeds increases the likelihood that they are intrusive.

#### *Actun Chechem Ha*

During the 2000 field season, investigations at Actun Chechem Ha were restricted to a brief reconnaissance to sample the contents of intact vessels on the cave's ledges and tunnels. Soil from the vessels was analyzed for macrofloral material and processed for starch grain analysis. Residue scraped from a ceramic sherd of a miniature vessel was also processed for starch grain analysis. In addition, a one-liter flotation sample was recovered from a surface hearth feature in Crawl 3 (CR3). During 1998 and 1999, researchers collected residues, soil samples, and macro-remains (Appendix A).

Time constraints did not permit the analysis of all the samples from preceding seasons. A small sample from each year was analyzed. These data were incorporated with the data from the 2000 season. Results of macrofloral analysis are presented in Table 5.6.

Archaeobotanical data from Actun Chechem Ha are restricted to the Late Classic period. All sampled vessels are attributable to the Late Classic period, and the remaining samples are from areas associated with predominantly Late Classic period ceramics. With the exception of a few samples from previous seasons and a single flotation sample collected in 2000, only intact vessels were sampled for macrofloral material. No samples are from stratified, archaeological deposits. In sum, the temporal depth of the botanical collection is limited, preventing chronological comparisons within the botanical collection.

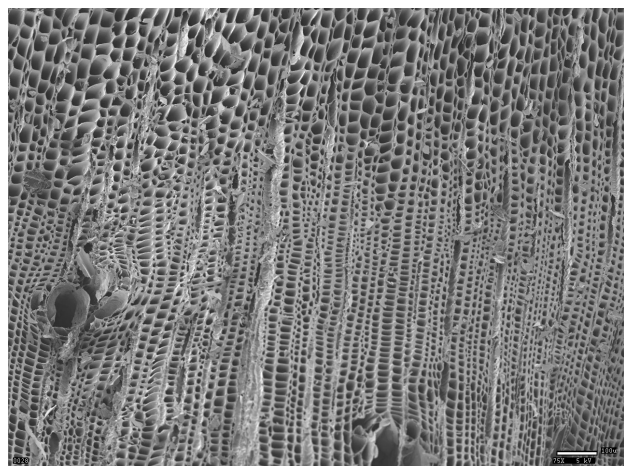


Figure 5.20: Pine (*Pinus* sp.) charcoal from Actun Chechem Ha X100 (Crawl [CR] 3, Hearth).

**Wood Charcoal.** Pine is the only taxon of burned wood recovered from Actun Chechem Ha (Figure 5.20). All vessels contained pine charcoal. Pine was retrieved from other contexts as well, including a number of features composed of stones aligned in circles. Pine also occurred between two ceramic sherds on Ledge 7 (L 7) and from

Table 5.6: Archaeobotanical Remains from Actun Chechem Ha, Cayo District, Belize. EP= elevated passage, VC= vessel contents, L= ledge, SC= stone circle, CH= chamber, T= tunnel, CR= crawl, \*= uncarbonized, – = unquantified.

| Provenience     | Plant                | Part     | Weight | #    | Vessel # | Vessel Type                | Sample Year |
|-----------------|----------------------|----------|--------|------|----------|----------------------------|-------------|
| EP1, VC1        | <i>Pinus</i> sp.     | Charcoal | 0.02   | -    | 11002201 | Jar: Cayo Unslipped        | 2000        |
|                 | <i>Solanum</i> sp.*  | Seeds    | > 0.01 | 24   |          |                            |             |
|                 | <i>Piper</i> sp.*    | Seeds    | 0.01   | 91   |          |                            |             |
|                 | <i>Cecropia</i> sp.* | Seeds    | > 0.01 | 31   |          |                            |             |
| EP1, VC2        | <i>Pinus</i> sp.     | Charcoal | 0.01   | -    | 11002301 | Jar: Cayo Unslipped        | 2000        |
|                 | <i>Solanum</i> sp.*  | Seeds    | > 0.01 | 23   |          |                            |             |
|                 | <i>Piper</i> sp.*    | Seeds    | 0.03   | 133  |          |                            |             |
| EP1, VC3        | <i>Pinus</i> sp.     | Charcoal | 0.01   | -    | 11002401 | Jar: Cayo Unslipped        | 2000        |
|                 | <i>Solanum</i> sp.*  | Seeds    | 0.06   | 231  |          |                            |             |
|                 | <i>Cecropia</i> sp.* | Seeds    | 0.03   | 101  |          |                            |             |
|                 | Unknown*             | Seeds    | 0.03   | 79   |          |                            |             |
| EP1, VC4        | <i>Pinus</i> sp.     | Charcoal | 0.02   | -    | 11003001 | Jar: Alexander's Unslipped | 2000        |
|                 | <i>Solanum</i> sp.*  | Seeds    | > 0.01 | 4    |          |                            |             |
|                 | <i>Cecropia</i> sp.* | Seeds    | > 0.01 | 18   |          |                            |             |
| EP1, VC5        | Unknown*             | Seeds    | 0.11   | >500 | 11004601 | Jar: Cayo Unslipped        | 2000        |
| EP1, VC6        | <i>Pinus</i> sp.     | Charcoal | 0.11   | -    | 11001501 | Jar: Cayo Unslipped        | 2000        |
|                 | <i>Solanum</i> sp.*  | Seeds    | > 0.01 | 20   |          |                            |             |
|                 | <i>Piper</i> sp.*    | Seeds    | > 0.01 | 67   |          |                            |             |
|                 | <i>Cecropia</i> sp.* | Seeds    | 0.02   | 47   |          |                            |             |
| EP1, VC7        | <i>Pinus</i> sp.     | Charcoal | 0.01   | -    | 11003401 | Jar: Cayo Unslipped        | 2000        |
|                 | <i>Solanum</i> sp.*  | Seeds    | > 0.01 | 23   |          |                            |             |
|                 | <i>Piper</i> sp.*    | Seeds    | 0.03   | 133  |          |                            |             |
| EP3             | <i>Zea mays</i>      | Cobs     | -      | 3    | ?        | Jar                        | 1998        |
| EP3             | <i>Pinus</i> sp.     | Charcoal | 0.24   | -    | -        | Under overhang             | 1999        |
| L4, SC8         | <i>Pinus</i> sp.     | Charcoal | 0.13   | -    | -        | -                          | 1998        |
| L4, SC9         | <i>Pinus</i> sp.     | Charcoal | 0.14   | -    | -        | -                          | 1998        |
| L5              | Unknown              | Residue  | 2.09   | -    | 11013508 | Surface of sherd           | 1999        |
| L6, Olla 3      | <i>Zea mays</i>      | Cobs     | -      | 4    | ?        | Jar                        | 1998        |
| L7, VC1         | <i>Pinus</i> sp.     | Charcoal | 0.22   | -    | 12015701 | Bowl: Mount Maloney Black  | 1999, 2000  |
|                 | <i>Solanum</i> sp.*  | Seeds    | 0.03   | 75   |          |                            |             |
| L7, VC1, cont'd | <i>Cecropia</i> sp.* | Seeds    | 0.02   | 58   | 12015701 | Bowl: Mount Maloney Black  | 1999, 2000  |
|                 | <i>Piper</i> sp.*    | Seeds    | 0.01   | 53   |          |                            |             |
|                 | Unknown*             | Seeds    | > 0.01 | 17   |          |                            |             |
| L7, VC2         | <i>Pinus</i> sp.     | Charcoal | > 0.01 | -    | 11016101 | Jar: Cayo Unslipped        | 2000        |
|                 | Unknown              | Residue  | 0.01   | -    |          |                            |             |

Table 5.6, cont'd

| Provenience<br>L7, VC2<br>cont'd | Plant<br><i>Cecropia</i> sp.*<br>Unknown*                                                          | Part<br>Seeds<br>Seeds                                   | Weight<br>> 0.01<br>> 0.01                         | #<br>31<br>18               | Vessel #                 | Vessel Type                                                | Sample Year      |
|----------------------------------|----------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------|-----------------------------|--------------------------|------------------------------------------------------------|------------------|
| L7, VC3                          | <i>Pinus</i> sp.                                                                                   | Charcoal                                                 | 0.16                                               | -                           | 11017301                 | Jar: Zibal<br>Unslipped                                    | 2000             |
| L10, S7                          | <i>Pinus</i> sp.                                                                                   | Charcoal                                                 | 0.21                                               | -                           | 91031501 &<br>11035001   | Between two<br>stacked sherds                              | 1999             |
| L11, SC                          | <i>Pinus</i> sp.<br><i>Solanum</i> sp.*<br><i>Piper</i> sp.*<br>Unknown*                           | Charcoal<br>Seeds<br>Seeds<br>Seeds                      | 0.07<br>> 0.01<br>> 0.01<br>0.01                   | -<br>7<br>8<br>21           | -                        | From shallow<br>pit with stone<br>circle                   | 1999             |
| CH3                              | <i>Pinus</i> sp.<br>Unknown<br><i>Piper</i> sp.*                                                   | Charcoal<br>Concretion<br>Seeds                          | 0.22<br>0.01<br>> 0.01                             | -<br>-<br>23                | 12026001                 | Bowl: Garbutt<br>Creek                                     | 1999             |
| CR3, VC1 (Hearth)                | <i>Pinus</i> sp.<br><i>Solanum</i> sp.*<br><i>Piper</i> sp.*                                       | Charcoal<br>Seeds<br>Seeds                               | 0.1<br>> 0.01<br>> 0.01                            | -<br>8<br>17                | 11045901                 | Jar: Zibal<br>Unslipped                                    | 2000             |
| CR3, Hearth                      | <i>Pinus</i> sp.<br><i>Zea mays</i><br><i>Solanum</i> sp.*<br>Unknown*                             | Charcoal<br>Kernels<br>Seeds<br>Seeds                    | 98.19<br>0.02<br>0.02<br>0.04                      | -<br>5<br>41<br>121         | -                        | Flotation<br>sample (2000)<br>Macrofossil<br>sample (1998) | 1998, 2000       |
| CR3                              | Unknown                                                                                            | Residue                                                  | 25.06                                              | -                           | ?                        | From surface<br>of sherd<br>FT-ICR MS                      | 1998             |
| T2, VC1                          | <i>Pinus</i> sp.                                                                                   | Charcoal                                                 | 1.13                                               | -                           | 11050201                 | Jar: Cayo<br>Unslipped                                     | 2000             |
| T2, VC2                          | <i>Pinus</i> sp.<br><i>Solanaceae</i> *<br>Unknown<br>Mammal                                       | Charcoal<br>Seeds<br>Residue<br>Droppings                | 0.04<br>> 0.01<br>1.36<br>0.03                     | -<br>2<br>-<br>-            | 11048901                 | Jar: Cayo<br>Unslipped                                     | 2000             |
| T2, VC3                          | <i>Pinus</i> sp.<br>Unknown<br>Unknown*<br><i>Solanum</i> sp.*<br><i>Cecropia</i> sp.*<br>Unknown* | Charcoal<br>Residue<br>Fibers<br>Seeds<br>Seeds<br>Seeds | > 0.01<br>0.12<br>0.22<br>> 0.01<br>> 0.01<br>0.03 | -<br>-<br>-<br>1<br>7<br>57 | 11050301<br><br>11050301 | Jar: Cayo<br>Unslipped<br><br>Jar: Cayo<br>Unslipped       | 2000<br><br>2000 |

underneath a natural cave overhang on Elevated Passage 3 (EP 3). A hearth feature located in Crawl 3 (CR 3) yielded a substantial amount, 98.19 g, of pine charcoal; 93 g of this amount was from a single, one-liter flotation sample collected in 2000 (Appendix A). No pine remains appeared to be from underdeveloped wood.

**Domesticated Plants.** Maize cobs and kernels were found at Actun Chechem Ha. Five fragmented kernels were recovered from the hearth feature in Crawl 3. The kernels were too incomplete for morphological analysis. In 1998, researchers collected a number of uncarbonized

maize cobs from Late Classic period jars on Ledge 6 and Elevated Passage 3. These cobs were kept in storage until analysis in 2000. The original number of individual cobs is unknown, but it was clear that some had disintegrated prior to 2000. Only seven cobs were available for analysis, four from Ledge 6 and three from Elevated Passage 3 (Figure 5.21). Morphological measurements of the maize cobs are presented in Table 5.7. Measurements were inflated 20% to correct for post-depositional shrinking. Due to differential preservation, measurements made on some specimens were not possible on others. For example, two specimens have well preserved glumes



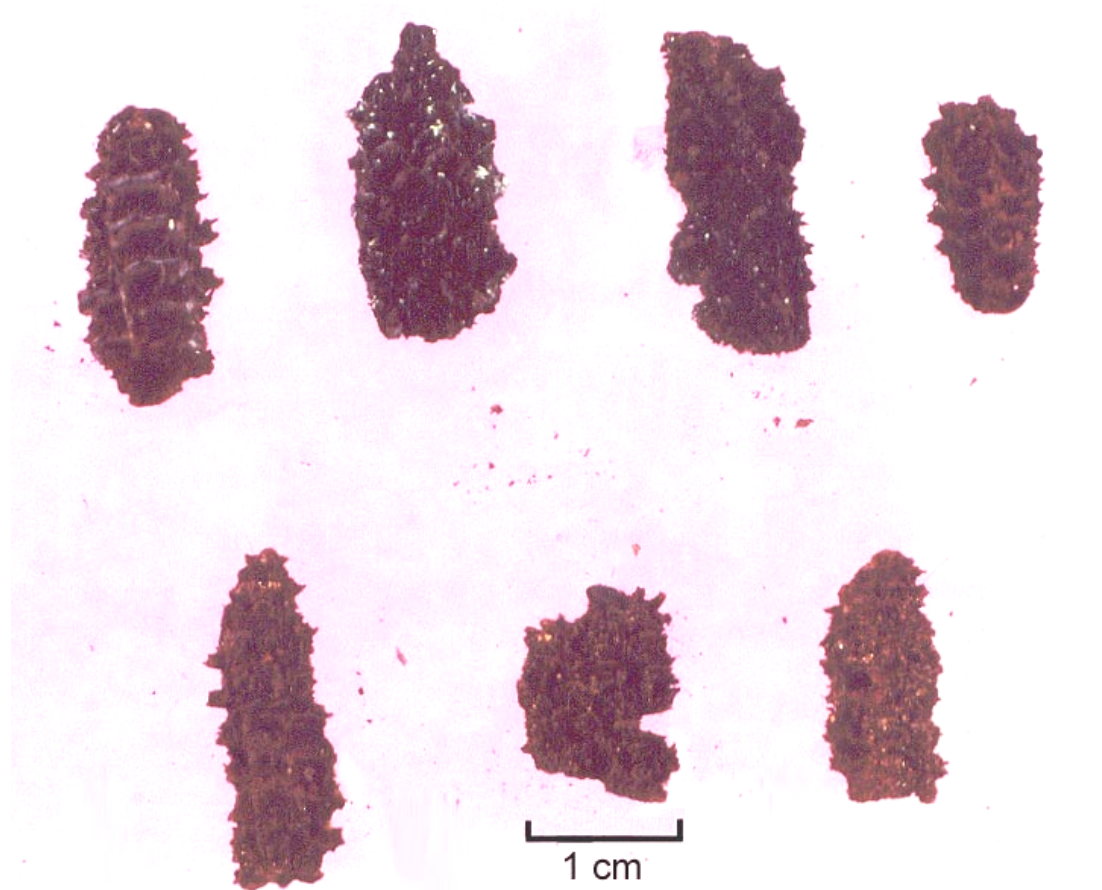


Figure 5.21: Maize cobs from Actun Chechem Ha. Cob designations (clockwise starting at upper left): 2a, 2b, 2c, 2d, 2e, 2f, 2g.

Table 5.7: Morphological measurements of maize cobs from Actun Chechem Ha. C= circular, T= tapered, S= straight, X-sec= cross section, Dia.= diameter, <sup>1</sup>= well preserved glumes [difficult to obtain cupule measurements], <sup>2</sup>= fragmentary [measurement not used to calculate overall mean], <sup>3</sup>= row number not affected by shrinkage).

| Provenience           | Cob             | Cupule Width | Cupule Length | Cupule Wing | Glume Width | Rachis Dia. | Cob Dia. | Cob Length         | Cob X-sec Shape | Long Shape | Row #          |
|-----------------------|-----------------|--------------|---------------|-------------|-------------|-------------|----------|--------------------|-----------------|------------|----------------|
| CCH, L 6, Olla 3      | 2a              | 4.22         | 1.68          | 1.08        | 2.44        | 6.68        | 9.4      | 18.26              | C               | T          | 10             |
| CCH, L 6, Olla 3      | 2b <sup>1</sup> | -            | -             | -           | 2.86        | -           | 10.18    | 20.6               | C               | T          | 10             |
| CCH, L 6, Olla 3      | 2c <sup>1</sup> | -            | -             | -           | 2.84        | 4.68        | 8.72     | 18.88              | C               | S          | 10             |
| CCH, L 6, Olla 3      | 2d              | 3.54         | 1.2           | 0.88        | 1.6         | 6.84        | 7.52     | 13.72              | C               | T          | 10             |
| CCH, EP 3             | 2e              | 3.56         | 1.48          | 0.8         | 2.18        | 5           | 7.5      | 22.01              | C               | T          | 10             |
| CCH, EP 3             | 2f              | 5.22         | 2.26          | 1.2         | 2.6         | 5           | 10.22    | 12.96 <sup>2</sup> | C               | T          | 10             |
| CCH, EP 3             | 2g              | 4.92         | 1.56          | 1.12        | 1.9         | 5.2         | 7.76     | 15.92              | C               | T          | 10             |
| <b>Average</b>        |                 | 4.2          | 1.64          | 1.02        | 2.35        | 5.57        | 8.76     | 18.23              | -               | -          | 10             |
| <b>20% Correction</b> |                 | 5.2          | 1.9           | 1.23        | 2.81        | 6.684       | 10.51    | 21.88              | -               | -          | - <sup>3</sup> |

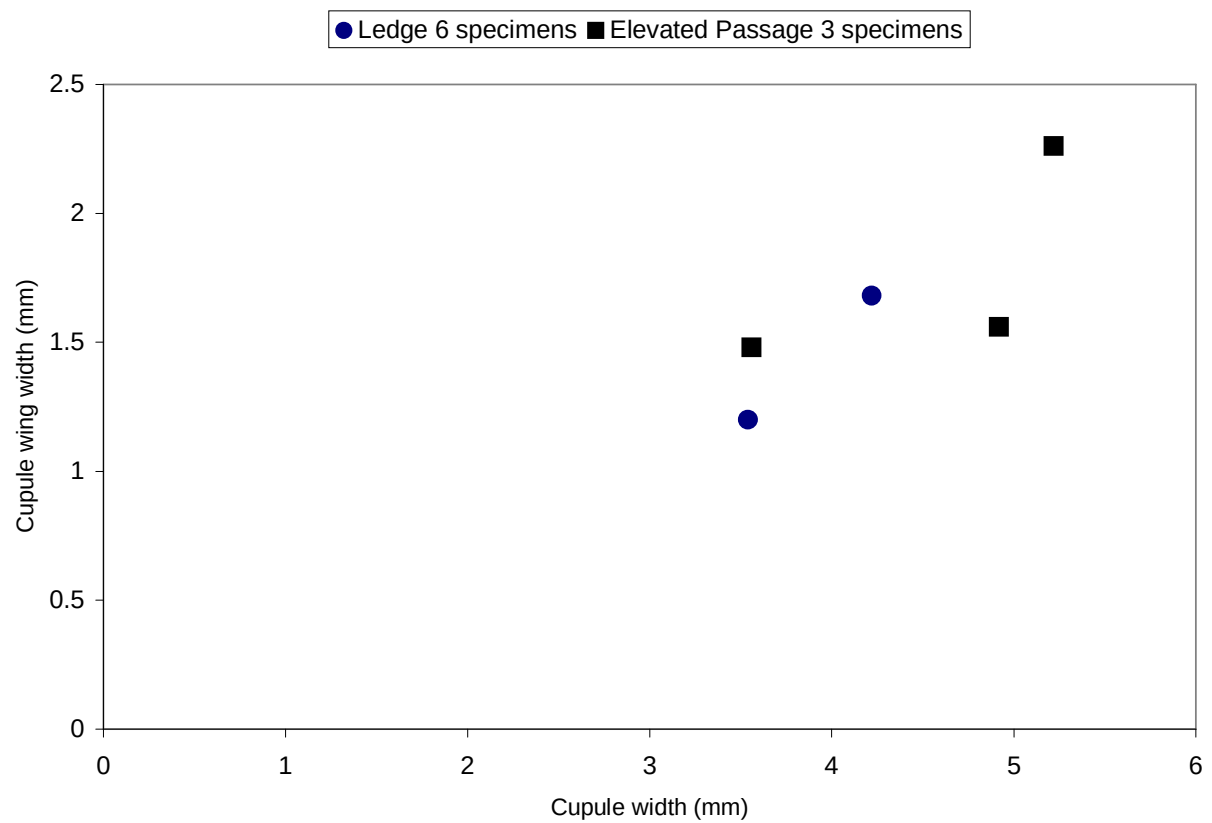


Figure 5.22: Comparison of maize from Actun Chechem Ha based on uncorrected cob length and cob diameter (n= 6).

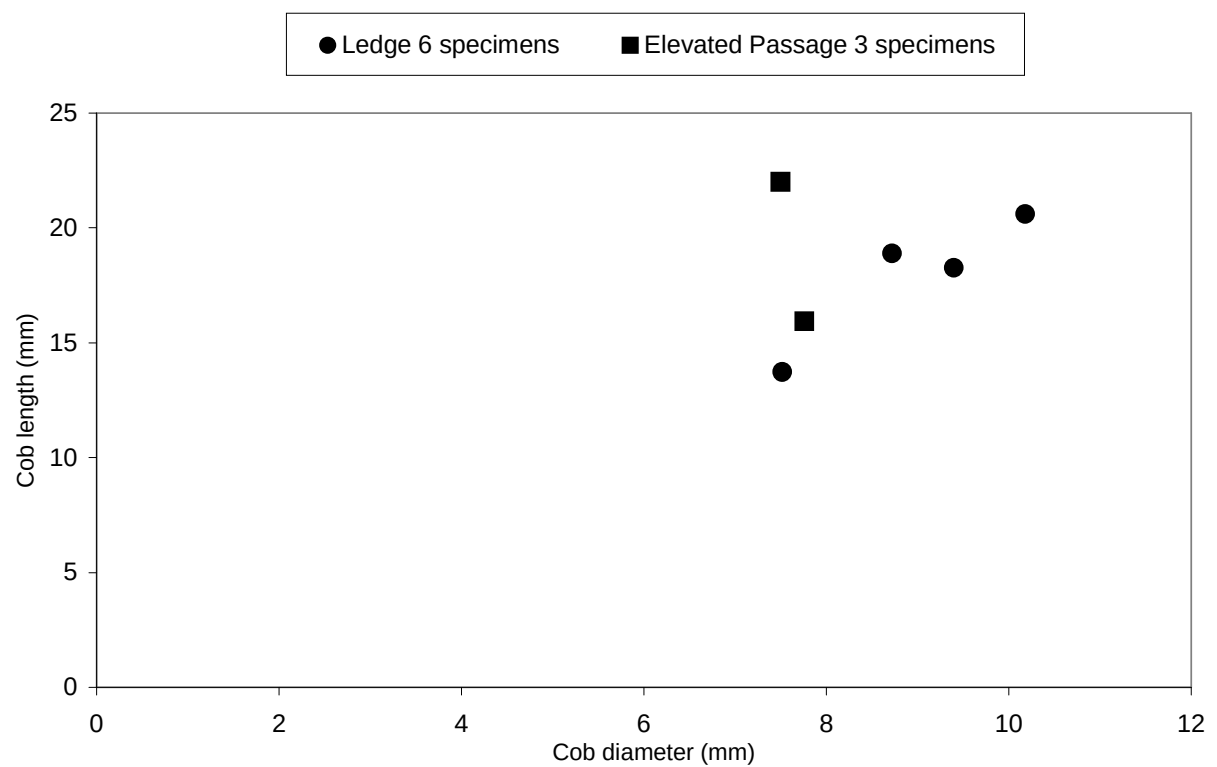


Figure 5.23: Comparison of maize from Actun Chechem Ha based on uncorrected cupule width and cupule wing width (n= 5).



Figures 5.24: Uncarbonized seeds from Actun Chechem Ha. 5.24a: *Cecropia* sp.. 5.24b: *Piper* sp.. 5.24c: *Solanum* sp. Marks indicate 1mm.

that obscure the cupules, preventing their measurement. The small size of the maize cobs is notable. The average length of the cobs is 18.23 mm. The longest individual cob is only 22.01 mm in length. The reduced length is not the result of post-depositional shrinkage. The maize is uncarbonized, and, thus, any shrinkage was probably minimal. The small size suggests that the cobs are from underdeveloped ears of maize.

The maize from both vessels appears taxonomically similar. All cobs are ten-rowed. Comparisons of morphological attributes of the specimens, such as cob length and cob diameter (Figure 5.22) and cupule width and cupule length (Figure 5.23), fail to cluster in separate groups, though the small sample size makes such comparisons tentative. The immaturity of the maize would constitute culturally significant information in itself.

Due to the immaturity of Actun Chechem Ha's maize cobs, bi-variate comparisons with prehistoric and extant maize types would likely lead to misleading results. Internal cob attributes of the small maize indicate similarity with early archaeological specimens such as those from Cuello. The Late Classic period date of these cobs makes this conclusion doubtful, however. Actun Chechem Ha's cobs appear morphologically closer to extant races with small internal cob features, such as Arrocillo.

Row number is a useful feature to assess taxonomic affiliation with modern types regardless of maturity. Unlike internal cob attributes, such as cupule measurements, maximum row number is established early in the development of a maize ear. The row number of Actun Chechem Ha's maize, ten, is substantially less than

that recorded for highland Arrocillo (Benz 1986; Wellhausen et al. 1952), excluding the possibility of affinity. Actun Chechem Ha's row numbers are within the range recorded for extant, lowland races and close to row numbers recorded for Classic period maize recovered from Copán (12 – 13) and Cerén (13.1) (Lentz 1991:272; Lentz et al. 1996a:273).

**Other Macrofloral Remains.** The remaining macrofloral remains consist of a number of uncarbonized seeds. Some seeds were unidentifiable, but most are species of *Solanum*, *Cecropia*, and *Piper* (Figure 5.24). The *Solanum* seeds require discussion. Prior to the present archaeobotanical analysis, archaeological reports on Actun Chechem Ha have described the reddish colored *Solanum* seeds as the spice and colorant achiote (*Bixa orellana*) or as pepper (*Capsicum annuum*) (Awe 1998:10; Ishihara 2000:54) and attributed cultural significance to them. There is no evidence to support the claim that the prehistoric users of Actun Chechem Ha intentionally deposited the *Solanum*, *Cecropia*, and *Piper* seeds, however. Ecological studies of seed dispersal patterns in the lowlands of Chiapas and Veracruz, Mexico, have revealed that the fruits of all three genera comprise a substantial portion of bats' diets (Galindo-González et al. 2000; Medellín and Gaona 1999). This factor, in conjunction with the uncarbonized condition of the seeds and their widespread occurrence at Actun Chechem Ha, indicates that these taxa were probably introduced to the cave in bat guano.

**Starch Grain Analysis.** Analysis of residues from ceramic sherds and soil from intact ceramic vessels yielded starch grains that are morphologically similar to maize starch (*Zea mays*) (Table 5.8). Figure 5.25a displays starch grains from a modern Nal Tel maize specimen collected by the author in northwest Quintana Roo, Mexico, and Figures 5.25b and 5.25c display starch grains recovered from Actun Chechem Ha. The archaeological grains are simple and spherical with a spherical central hilum. In clusters, the grains are somewhat polyhedral with slightly sharp edges, a characteristic of *Zea mays* starch (Reichert 1913:199) (Figure 5.25b). The size of the grains ranges from 15 to 26 $\mu$ , within the size range of *Zea mays*. Some starch grains were only tentatively identified as maize. Identification of these examples was hindered either by poor preservation or by the rapid absorption of iodine, which obscured morphological features. The sample of vessels that yielded starch is too small to propose any association between starch grains and vessel types. It is noteworthy that maize starch grains were recovered from three Late Classic period vessel types, including a miniature vessel, a bowl, and three jars. The fact that more jars yielded maize starch grains may reflect sampling because more jars were sampled than other vessel types.

**Residue Analysis.** Carbonized residues were recovered from five locations in Actun Chechem Ha (Table 5.6). Fourier Transform-Ion Resonance Mass Spectrometry

Table 5.8: Results of starch grain analysis on residue and soil samples.

| Residues     |                      |               |               |               |                                              |             |
|--------------|----------------------|---------------|---------------|---------------|----------------------------------------------|-------------|
| Provenience  | Plant                | Part          | Quantity      | Vessel #      | Comments                                     | Sample Year |
| CR3, VC2     | <i>Zea mays</i>      | Starch grains | 4             | 22044301      | Miniature vessel (Late Classic)              | 2000        |
| CR3          | Sterile              | -             | -             | ?             | Submitted for chemical analysis (FT-ICR MS)  | 1998        |
| L5           | <i>Zea mays</i>      | Starch grains | 8             | 13013801      | Lip to lip cache. Uacho Black on Orange bowl | 1998        |
| Soil samples |                      |               |               |               |                                              |             |
| Provenience  | Plant                | Part Found    | Quantity      | Vessel Number | Comments                                     | Sample Year |
| L7, VC1      | Sterile              | -             | -             | 12015701      | Bowl: Mount Maloney Black                    | 2000        |
| L7, VC2      | <i>Zea mays</i>      | Starch grains | Cluster (+10) | 11016101      | Jar: Cayo Unslipped                          | 2000        |
| EP1, VC1     | Sterile              | -             | -             | 11002201      | Jar: Cayo Unslipped                          | 2000        |
| EP1, VC2     | <i>Zea mays</i> (?)  | Starch grain  | 1             | 11002301      | Jar: Cayo Unslipped                          | 2000        |
| EP1, VC3     | Sterile              | -             | -             | 11002401      | Jar: Cayo Unslipped                          | 2000        |
| EP1, VC5     | Sterile              | -             | -             | 11004601      | Jar: Cayo Unslipped                          | 2000        |
| EP1, VC6     | Sterile              | -             | -             | 11001501      | Jar: Cayo Unslipped                          | 2000        |
| EP1, VC7     | Sterile              | -             | -             | 11003401      | Jar: Cayo Unslipped                          | 2000        |
| T2, VC2      | <i>Zea mays</i>      | Starch grains | 37            | 11048901      | Jar: Cayo Unslipped                          | 2000        |
|              | c.f. <i>Zea mays</i> | Starch grains | 26            |               |                                              |             |
| T2, VC3      | Sterile              | -             | -             | 11050301      | Jar: Cayo Unslipped                          | 2000        |
| CR3, VC1     | Sterile              | -             | -             | 11045901      | Jar: Zibal Unslipped                         | 2000        |



Figure 5.25: Maize starch grains. 5.25a: Starch grains from modern maize. 5.25b: Cluster of maize starch grains from Actun Chechem Ha (Vessel # 11016101). 5.25c: Solitary maize starch grain from Actun Chechem Ha (Vessel # 22044301).

## Actun CheChem Ha vs. Comparative Sample

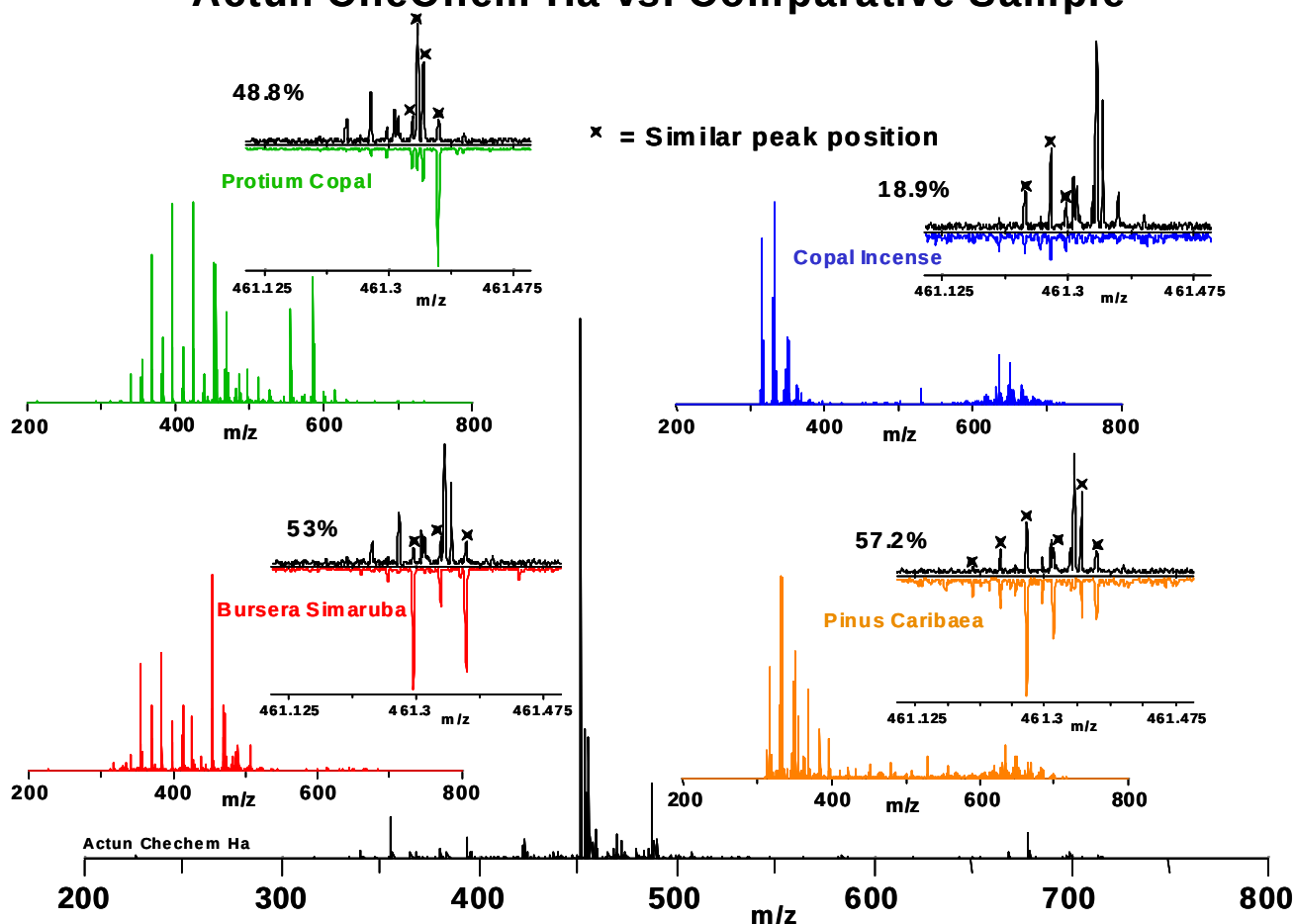


Figure 5.26: Results of Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) conducted on a carbonized residue sample from Crawl 3 (CR3).

(FT-ICR MS) was conducted on a sample collected from the surface of a ceramic sherd from Crawl 3 (CR3) (Figure 5.26). The residue was amorphous and appeared visually similar to burned copal incense. FT-ICR MS revealed 402 measurable molecular peaks in the archaeological sample. Out of the five comparative samples, *Bursera simaruba*, *Protium copal*, *Pinus caribaea*, and copal incense, the archaeological sample shows the greatest similarity with *Pinus caribaea*. *P. caribaea* and the archaeological specimen share 230 peaks, 57.2%. The archaeological sample also displays similarities with members of the Burseraceae family, *Protium copal* and *Bursera simaruba*. Fifty-three percent and 49% of the molecular peaks are shared with *B. simaruba* and *P. copal*, respectively. The sample of copal incense has only 18.9% of peaks in common with the archaeological sample. These results suggest that chemical compounds found in pine and Burseraceae taxa are abundant in the archaeological sample.

### Barton Creek Cave

Archaeobotanical data from Barton Creek Cave were obtained through the collection of one-liter flotation

samples and the recovery of carbonized macrofossils during excavations. Samples were taken from stratigraphically shallow deposits, including surface hearth features and bone clusters, or concentrations of human remains containing one or more individuals in primary contexts. Fourteen flotation samples were collected from six archaeological deposits, and 24 macrofossil samples were recovered from 13 deposits (Appendix A). Identifications are presented in Table 5.9. Numerous macrofossil samples were retrieved from disturbed or potentially disturbed surface concentrations of charcoal (Appendix A). These data are not included in Table 5.9.

**Wood Charcoal.** Carbonized wood is the dominant archaeobotanical remain recovered from Barton Creek Cave (Figure 5.27). Pine and a number of hardwood taxa were identified. Ubiquity and weight comparisons were employed to ascertain the relative importance of wood charcoal. Pine, *Protium* sp., and *Piscidia* sp. were the dominant genera of wood charcoal by both ubiquity and weight.

Because multiple flotation samples were often taken from

Table 5.9: Archaeobotanical Remains from Barton Creek Cave. U= Unit, L= Level, F= Feature, BC= bone cluster, AC= artifact cluster, N-W= northwest section of unit, N-E= northeast section of unit, <sup>1</sup>= fragments, <sup>2</sup>= complete and fragments, <sup>3</sup>= uncarbonized, – = unquantified.

| Provenience                            | Plant                                  | Part           | Weight | #   | ID Number    |
|----------------------------------------|----------------------------------------|----------------|--------|-----|--------------|
| Ledge 2, Area B, U9, L1                | <i>Allophylus</i> sp.                  | Charcoal       | 0.22   | -   | 10040        |
|                                        | <i>Piscidia</i> sp.                    | Charcoal       | 0.17   | -   |              |
|                                        | Burseraceae                            | Charcoal       | 0.13   | -   |              |
|                                        | Hardwood                               | Charcoal       | 6.22   | -   |              |
|                                        | Dicot                                  | Charcoal       | 0.34   | -   |              |
| Ledge 2, Area B, U9, L2, FB (ash lens) | <i>Pinus</i> sp.                       | Charcoal       | 0.49   | -   | 10043        |
|                                        | <i>Cedrela</i> sp.                     | Charcoal       | 2.09   | -   |              |
|                                        | <i>Ficus</i> sp.                       | Charcoal       | 0.56   | -   |              |
|                                        | <i>Protium</i> sp.                     | Charcoal       | 1.8    | -   |              |
|                                        | Burseraceae                            | Charcoal       | 5.84   | -   |              |
|                                        | Moraceae                               | Charcoal       | 0.11   | -   |              |
|                                        | Leguminosae                            | Charcoal       | 0.07   | -   |              |
| Ledge 2, Area B, U9, L2, N-W           | <i>Pinus</i> sp.                       | Charcoal       | 1.11   | -   | 10039        |
|                                        | <i>Piscidia</i> sp.                    | Charcoal       | 0.32   | -   |              |
|                                        | <i>Lonchocarpus</i> sp.                | Charcoal       | 0.47   | -   |              |
| Ledge 2, Area B, U9, L2, N-E           | <i>Lonchocarpus</i> sp.                | Charcoal       | 0.12   | -   | 10041        |
|                                        | <i>Persea</i> sp.                      | Charcoal       | 1.1    | -   |              |
|                                        | <i>Piscidia</i> sp.                    | Charcoal       | 0.3    | -   |              |
|                                        | Leguminosae                            | Charcoal       | 0.26   | -   |              |
|                                        | Burseraceae                            | Charcoal       | 0.32   | -   |              |
|                                        | Hardwood                               | Charcoal       | 0.9    | -   |              |
| Ledge 2, Area B, U9, L3/4              | <i>Pinus</i> sp.                       | Charcoal       | 0.9    | -   | 10044-10045  |
|                                        | <i>Byrsonima</i> sp.                   | Charcoal       | 0.39   | -   |              |
|                                        | <i>Ficus</i> sp.                       | Charcoal       | 3.48   | -   |              |
|                                        | <i>Piscidia</i> sp.                    | Charcoal       | 0.53   | -   |              |
|                                        | <i>Protium</i> sp.                     | Charcoal       | 0.23   | -   |              |
|                                        | Sapotaceae                             | Charcoal       | 0.04   | -   |              |
|                                        | Dicot                                  | Charcoal       | 0.05   | -   |              |
|                                        | Euphorbiaceae                          | Charcoal       | 0.15   | -   |              |
|                                        | Moraceae                               | Charcoal       | 0.49   | -   |              |
|                                        |                                        |                |        |     |              |
| Ledge 2, Area C, F23                   | <i>Pinus</i> sp.                       | Charcoal       | 4.43   | -   | 10062-10068  |
|                                        | <i>Protium</i> sp.                     | Charcoal       | 37.56  | -   |              |
|                                        | <i>Theobroma</i> sp.                   | Charcoal       | 0.62   | -   |              |
|                                        | <i>Byrsonima</i> sp.                   | Charcoal       | 2.4    | -   |              |
|                                        | <i>Zanthoxylum</i> sp.                 | Charcoal       | 6.77   | -   | 20038-20038a |
|                                        | Burseraceae                            | Charcoal       | 2.18   | -   |              |
|                                        | Rubiaceae                              | Charcoal       | 0.9    | -   |              |
|                                        | Hardwood                               | Charcoal       | 5.63   | -   |              |
|                                        | Weedy genus                            | Shoots         | 15.76  | -   | 20042-20044  |
|                                        | <i>Zea mays</i>                        | Shoots         | 40.12  | -   |              |
|                                        | <i>Zea mays</i>                        | Kernels        | 18.88  | 313 |              |
|                                        | <i>Zea mays</i>                        | Cupules        | 0.23   | 22  |              |
|                                        | <i>Zea mays</i> <sup>2</sup>           | Cobs/ears      | 20.56  | 17  | 20042-20044  |
|                                        | <i>Cucurbita</i> sp.                   | Rind           | 0.52   | -   |              |
|                                        | <i>Cucurbita</i> sp. <sup>1</sup>      | Seed           | 0.01   | 1   |              |
|                                        | <i>Cucurbita pepo</i> <sup>2</sup>     | Seed           | 0.15   | >2  |              |
|                                        | <i>Cucurbita moschata</i> <sup>2</sup> | Seed           | 0.02   | >2  |              |
|                                        | <i>Capsicum annuum</i>                 | Seed           | 0.06   | 41  |              |
|                                        | <i>Capsicum annuum</i>                 | Calyx          | 0.01   | 1   |              |
|                                        | <i>Gossypium</i> sp.                   | Fibers/textile | -      | -   |              |
|                                        |                                        |                |        |     |              |
|                                        |                                        |                |        |     |              |

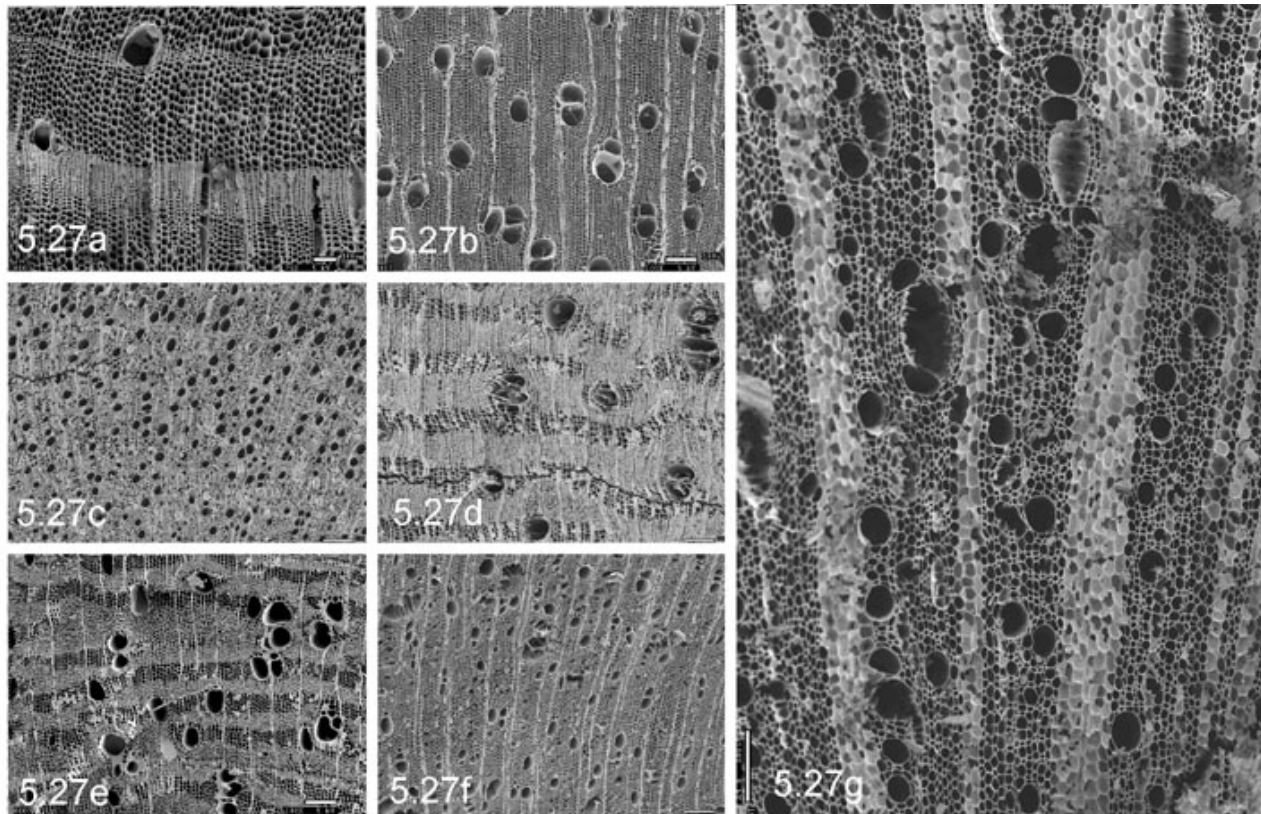
Table 5.9, cont'd.

| Provenience                     | Plant                               | Part        | Weight | #  | ID Number             |
|---------------------------------|-------------------------------------|-------------|--------|----|-----------------------|
| Ledge 2, Area C,<br>F23, cont'd | <i>Vitis tiliifolia</i>             | Seed        | > 0.01 | 1  |                       |
|                                 | <i>Phaseolus</i> sp. ? <sup>1</sup> | Cotyledon   | 0.01   | 1  |                       |
|                                 | Unknown                             | Fibrous ash | 7.71   | -  |                       |
|                                 | Unknown                             | Residue     | 6.11   | -  |                       |
|                                 | Dicot                               | Floral buds | 0.04   | 4  |                       |
|                                 | Unknown                             | Seed        | 0.01   | 1  |                       |
| Ledge 2, Area D,<br>BC25        | <i>Pinus</i> sp.                    | Charcoal    | 0.62   | -  | 10055                 |
|                                 | <i>Zea mays</i> <sup>1</sup>        | Kernels     | 0.04   | 3  |                       |
|                                 | Unknown                             | Residue     | 0.03   | -  |                       |
| Ledge 3, Area A,<br>BC26        | <i>Pinus</i> sp.                    | Charcoal    | 0.74   | -  | 20036, 20037          |
|                                 | <i>Zea mays</i> <sup>1</sup>        | Kernels     | 0.72   | -  |                       |
|                                 | <i>Pouteria</i> sp.                 | Charcoal    | 0.12   | -  |                       |
|                                 | Burseraceae                         | Charcoal    | 0.03   | -  |                       |
| Ledge 3, Area A,<br>AC56        | Sterile                             | -           | -      | -  | 20045                 |
| Ledge 6, BC13                   | <i>Pinus</i> sp.                    | Charcoal    | 0.03   | -  | 10058                 |
|                                 | <i>Protium</i> sp.                  | Charcoal    | 0.02   | -  |                       |
|                                 | Euphorbiaceae                       | Charcoal    | 0.31   | -  |                       |
|                                 | Hardwood                            | Charcoal    | 0.04   | -  |                       |
|                                 | Dicot                               | Charcoal    | 0.04   | -  |                       |
|                                 | <i>Vitis tiliifolia</i>             | Seed        | > 0.01 | 1  |                       |
|                                 | Unknown                             | Seed        | > 0.01 | 1  |                       |
|                                 | Unknown <sup>3</sup>                | Disseminule | > 0.01 | 1  |                       |
| Ledge 6, Area A,<br>U2          | <i>Pinus</i> sp.                    | Charcoal    | 2.79   | -  | 20041, 20046<br>20047 |
|                                 | <i>Piscidia</i> sp.                 | Charcoal    | 11.86  | -  |                       |
|                                 | <i>Byrsonima</i> sp.                | Charcoal    | 2.16   | -  |                       |
|                                 | <i>Cedrela</i> sp.                  | Charcoal    | 1.66   | -  |                       |
|                                 | <i>Lonchocarpus</i> sp.             | Charcoal    | 0.62   | -  |                       |
|                                 | <i>Lysiloma</i> sp.                 | Charcoal    | 1.06   | -  |                       |
|                                 | <i>Protium</i> sp.                  | Charcoal    | 0.35   | -  |                       |
|                                 | Burseraceae                         | Charcoal    | 0.83   | -  |                       |
|                                 | Lauraceae                           | Charcoal    | 0.5    | -  |                       |
|                                 | Hardwood                            | Charcoal    | 2.01   | -  |                       |
|                                 | Dicot                               | Charcoal    | 1.32   | -  |                       |
|                                 | <i>Phaseolus vulgaris</i>           | Seed        | 0.04   | 1  |                       |
|                                 | <i>Zea mays</i> <sup>2</sup>        | Kernels     | 0.02   | >1 |                       |
|                                 | Compositae                          | Achene      | > 0.01 | 1  |                       |
|                                 | Dicot                               | Rind        | 0.19   | -  |                       |
|                                 | Unknown                             | Disseminule | > 0.01 | 2  |                       |
| Ledge 7, Area A,<br>U3, Hearth  | <i>Pinus</i> sp.                    | Charcoal    | 0.08   | -  | 20040                 |
|                                 | <i>Zea mays</i> <sup>1</sup>        | Kernels     | 0.04   | -  |                       |
|                                 | <i>Terminalia</i> sp.               | Charcoal    | 0.04   | -  |                       |
|                                 | Sapotaceae                          | Charcoal    | 0.02   | -  |                       |
| Ledge 8, Area B,<br>BC1         | <i>Pinus</i> sp.                    | Charcoal    | 1.16   | -  | 20039                 |
|                                 | Sapotaceae                          | Charcoal    | 2.91   | -  |                       |
|                                 | Burseraceae                         | Charcoal    | 0.61   | -  |                       |
|                                 | Lauraceae                           | Charcoal    | 0.06   | -  |                       |
|                                 | <i>Zea mays</i>                     | Kernels     | 0.07   | 3  |                       |
|                                 | <i>Zea mays</i>                     | Cupules     | 0.02   | 6  |                       |
|                                 | <i>Zea mays</i> <sup>1</sup>        | Cob         | > 0.01 | 1  |                       |



Table 5.9, cont'd.

| Provenience                    | Plant                  | Part     | Weight | # | ID Number   |
|--------------------------------|------------------------|----------|--------|---|-------------|
| Ledge 8, Area C,<br>U8, Hearth | <i>Pinus</i> sp.       | Charcoal | 0.1    | - | 10060-10061 |
|                                | <i>Zanthoxylum</i> sp. | Charcoal | 0.33   | - |             |
|                                | <i>Pouteria</i> sp.    | Charcoal | 0.08   | - |             |
|                                | <i>Byrsonima</i> sp.   | Charcoal | 1.28   | - |             |
|                                | Hardwood               | Charcoal | 0.45   | - |             |
| Ledge 9, Area B,<br>F40        | Euphorbiaceae          | Charcoal | 54.76  | - | 10038       |



Figures 5.27: Wood charcoal from Barton Creek Cave. 5.27a: *Pinus* sp. X75 (10039-001), 5.27b: *Protium* sp. X100 (10043-008). 5.27c: *Aspidosperma* sp. X100 (10051-010). 5.27d: *Piscidia* sp. X100 (20041-001). 5.27e: *Allophylus* sp. X100 (10040-001). 5.27f: *Zanthoxylum* sp. X100 (10060-001). 5.27g: *Theobroma* sp. X100 (10067b-003).

one deposit, weight measurements based only on flotation samples were standardized by dividing the weight of the measured taxon by the number of samples. Both hardwood and pine charcoal have high ubiquity values, although hardwoods occur more frequently. Ninety-three percent of sampled deposits yielded hardwood charcoal whereas only 73% of deposits yielded pine (Figure 5.28). Comparisons based on the weights of hardwoods and pine from one-liter flotation samples reveal that the weight of hardwoods is greater than that of pine (Figure 5.29). A total of 13.66 g of hardwood charcoal were recovered versus 3.21 g of pine. If the total weight of pine and hardwood charcoal from all samples, including material from macrofossil samples, is compared, the disparity between hardwood and pine charcoal is increased (164.48 g of hardwood charcoal and 12.45 g of pine charcoal were recovered from all samples).

Although ubiquity measurements demonstrate that the burning of pine and hardwood charcoal was a regular activity, weight measurements show that substantially more hardwoods were burned.

The relative importance of individual genera of wood charcoal was measured through ubiquity analysis (Figure 5.30). Pine charcoal was recovered from the highest number of archaeological deposits (73%). *Piscidia* sp. and *Protium* sp. were found in 33% of deposits, followed by *Byrsonima* sp. (27%) and *Lonchocarpus* sp. (20%). *Cedrela* sp., *Ficus* sp., *Zanthoxylum* sp. and *Pouteria* sp. were retrieved from 13% of deposits. The remaining charcoal genera, *Allophylus* sp., *Persea* sp., *Theobroma* sp., *Lysiloma* sp. and *Terminalia* sp., were recovered from one archaeological deposit each (7%).



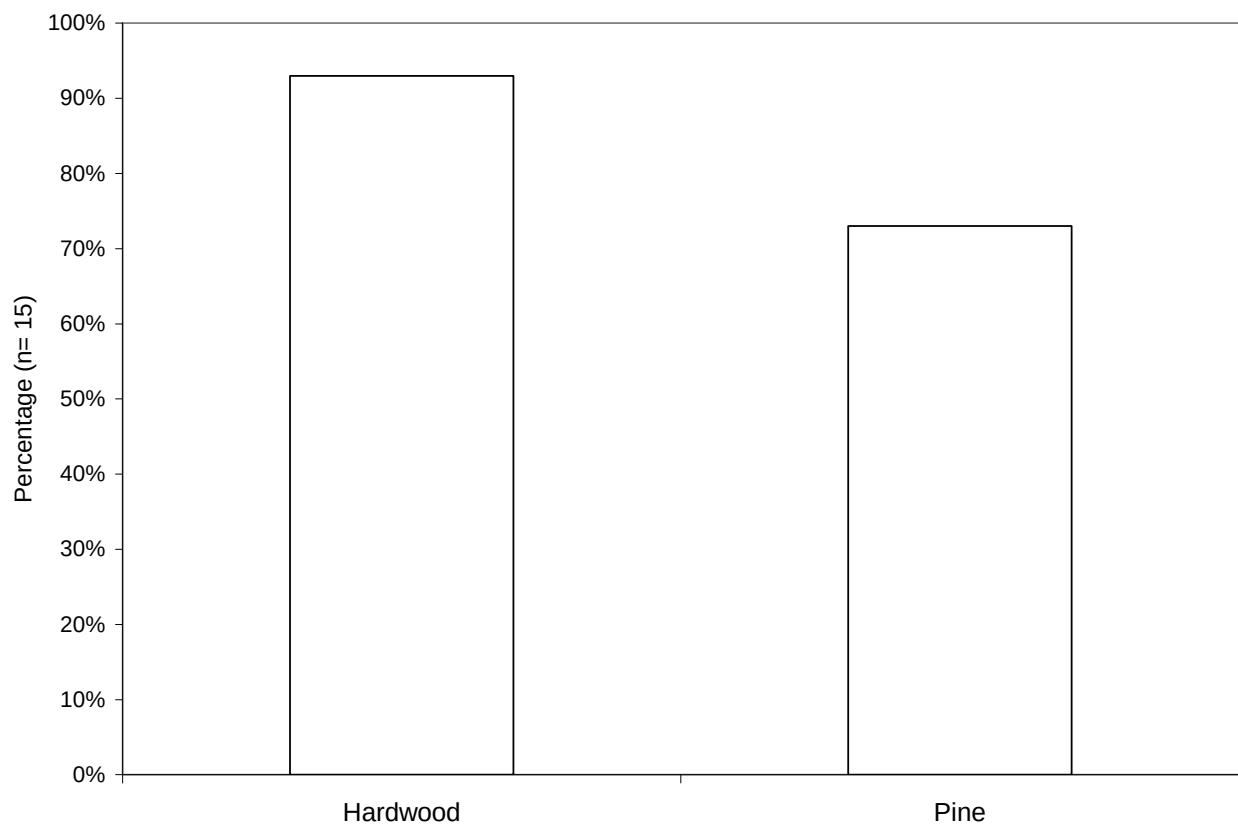


Figure 5.28: Differences between pine and hardwood charcoal from Barton Creek Cave measured by ubiquity.



Figure 5.29: Difference between pine and hardwood charcoal from Barton Creek Cave measured by weight (n= 6)

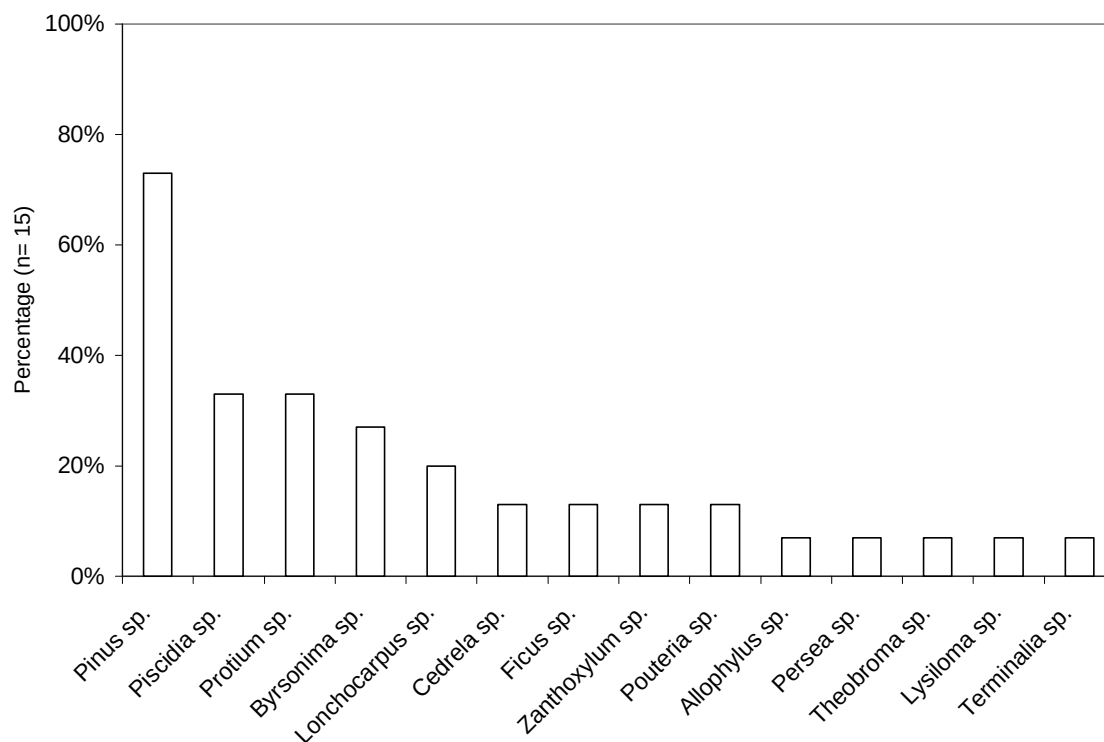


Figure 5.30: Distribution of individual genera of wood charcoal from Barton Creek Cave measured by ubiquity.

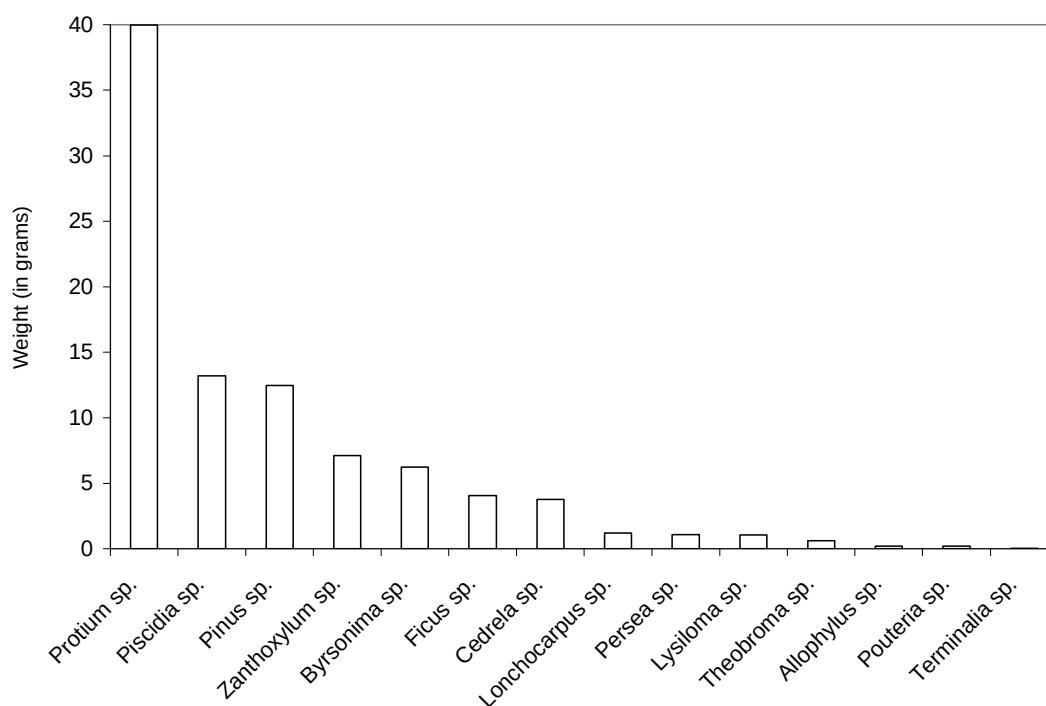


Figure 5.31: Distribution of individual genera of wood charcoal measured by weight.

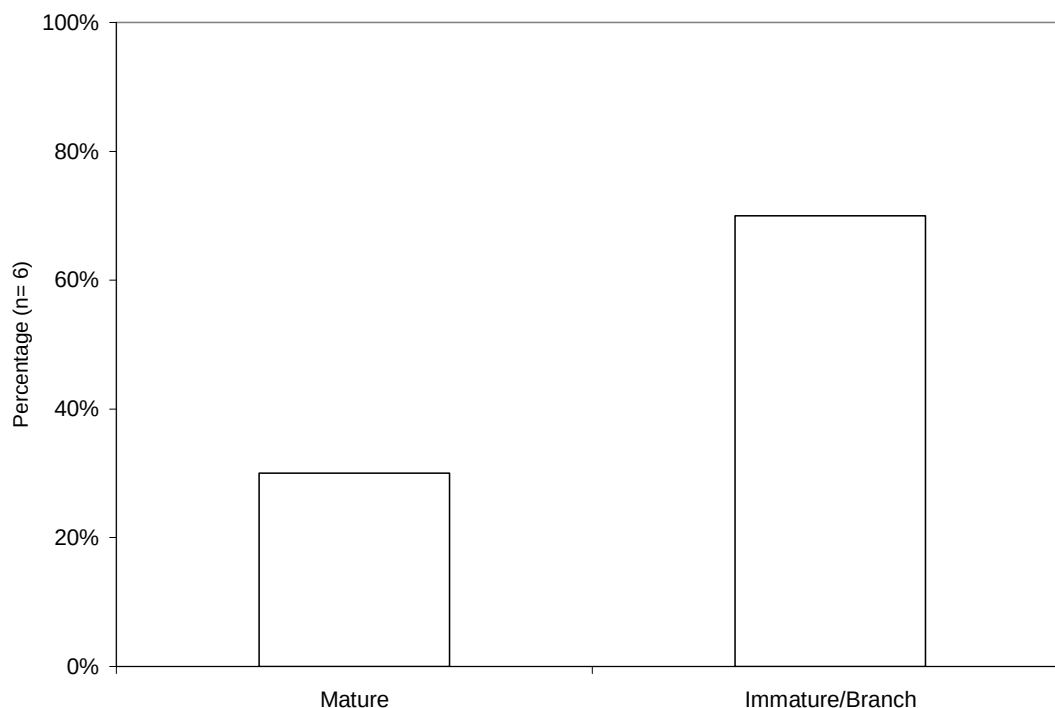


Figure 5.32: Difference in the proportion of mature versus immature wood or branches in the overall charcoal assemblage from Barton Creek Cave.

Weight measurements were also used to examine the relative importance of individual genera of wood charcoal (Figure 5.31). Charcoal weights from both macrofossil and flotation samples were quantified because some genera are only represented in macrofossil samples. Despite the differences between ubiquity and weight measurements, pine, *Protium* sp., and *Piscidia* sp. are the three dominant genera of wood charcoal measured by both weight and ubiquity. Unlike ubiquity values for pine, pine charcoal is not dominant by weight. *Protium* sp. was the heaviest genus with 39.96 g of charcoal, more than three times heavier than the next most abundant charcoal, *Piscidia* sp., which yielded only 13.18 g of charcoal. Pine was the third heaviest genus, comprising 12.45 g of Barton Creek's charcoal assemblage.

Many charcoal specimens of hardwoods from Barton Creek Cave appeared to be from either young stems or branches. Only hardwood charcoal appeared to be from young stems or branches. Figure 5.32 illustrates the proportion of mature versus immature stems or branches in the total weight of wood charcoal from one-liter flotation samples. Immature stems or branches compose 70% of Barton Creek Cave's charcoal assemblage, indicating that young stems were the preferred form of wood selected by groups who used Barton Creek Cave in the Late Classic period.

**Domesticated Plants.** Archaeobotanical remains from a number of domesticated cultigens were recovered from Barton Creek Cave (Table 5.9, Figure 5.33). Few bean remains were found. One complete common bean (*Phaseolus vulgaris*) was recovered (Figure 5.33a), and

one fragmented cotyledon was tentatively identified as a species of *Phaseolus*.

Squash remains consist of rind fragments and seeds found together in a single context, Feature 23, suggesting that entire squash fruits were deposited. Feature 23 is a large hearth feature located on Ledge 2, Area C (see below) that was covered in rocks that spalled off the cave wall and ceiling. One fragmented squash seed and rind fragments were identified as *Curcubita* sp. The remaining seeds are composed of two species of squash, *Curcubita pepo* and *Curcubita moschata* (Figure 5.33b,d).

Forty-one chile pepper (*Capsicum annuum*) seeds and a chile pepper calyx, or fruit base, were also found in Feature 23 (Figure 5.33c). As with the squash, the association of the calyx and the seeds indicates that whole fruits were deposited.

Carbonized maize (*Zea mays*) remains were the most ubiquitous domesticated plant recovered from Barton Creek Cave. Forty percent of sampled deposits contained maize. The maize remains consist of kernels, cupules, cobs, complete ears, and stem fragments. Most deposits yielded fragmentary kernels. Only two deposits contained maize that was adequately preserved for morphological analysis, Feature 23 and Bone Cluster 1 (Table 5.10). The maize from Bone Cluster 1 consists of six cupules, three complete kernels, and one larger cob fragment. The maize remains from Feature 23 are diverse, including complete cobs and ears, individual kernels, and stem fragments (Figures 5.34-5.35). A number of the cobs are small and

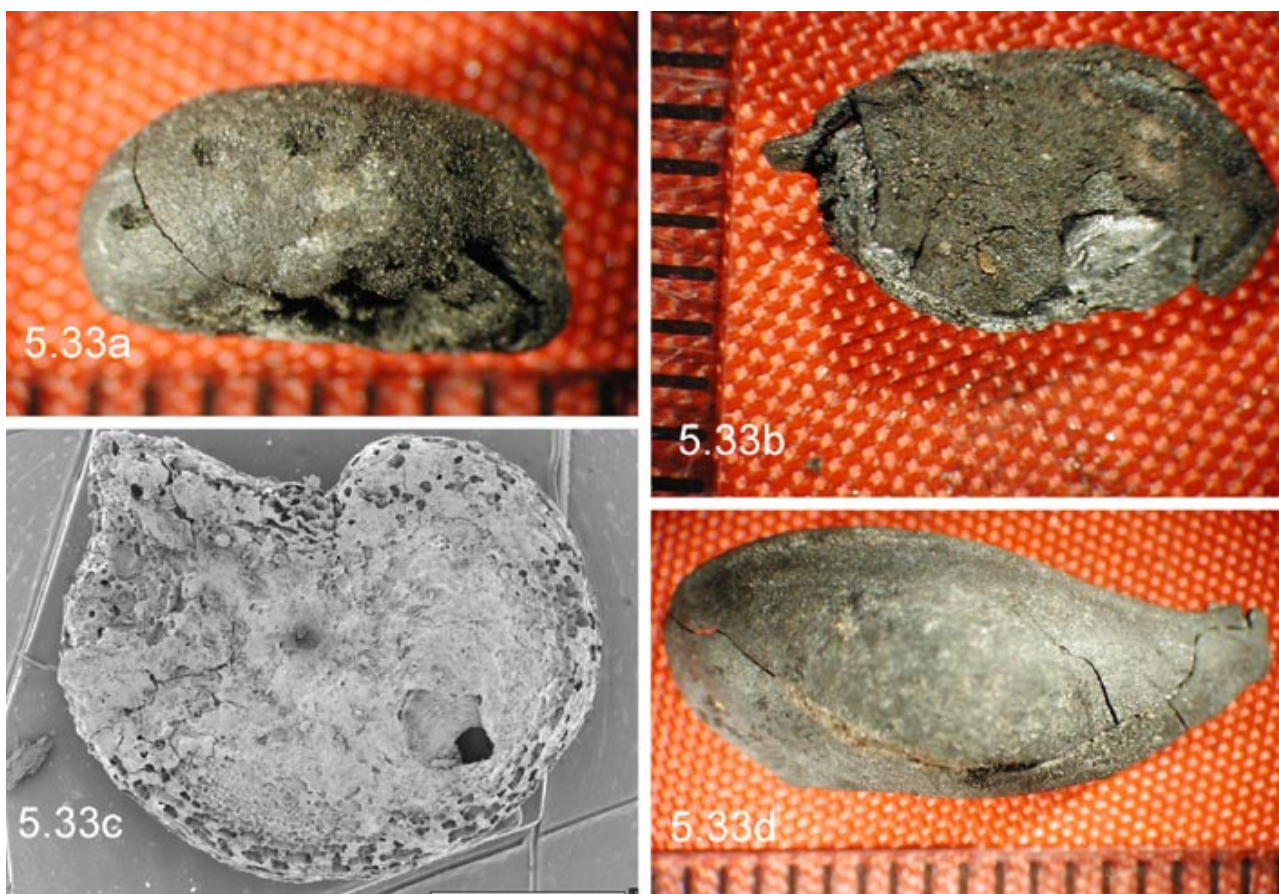


Figure 5.33: Remains of domesticated plant foods from Barton Creek Cave. 5.33a: *Phaseolus vulgaris* seed (Marks indicate 1mm) (20046-006). 5.33b: *Cucurbita moschata* seed (Marks indicate 1mm) (20043-005). 5.33c: *Capsicum annuum* seed X35 (20043-006). 5.33d: *Cucurbita pepo* (Marks indicate 1mm).



Figure 5.34: Complete and incomplete maize ears and cobs from Barton Creek Cave, Feature 23. Cob designations (clockwise starting at upper left): 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h.



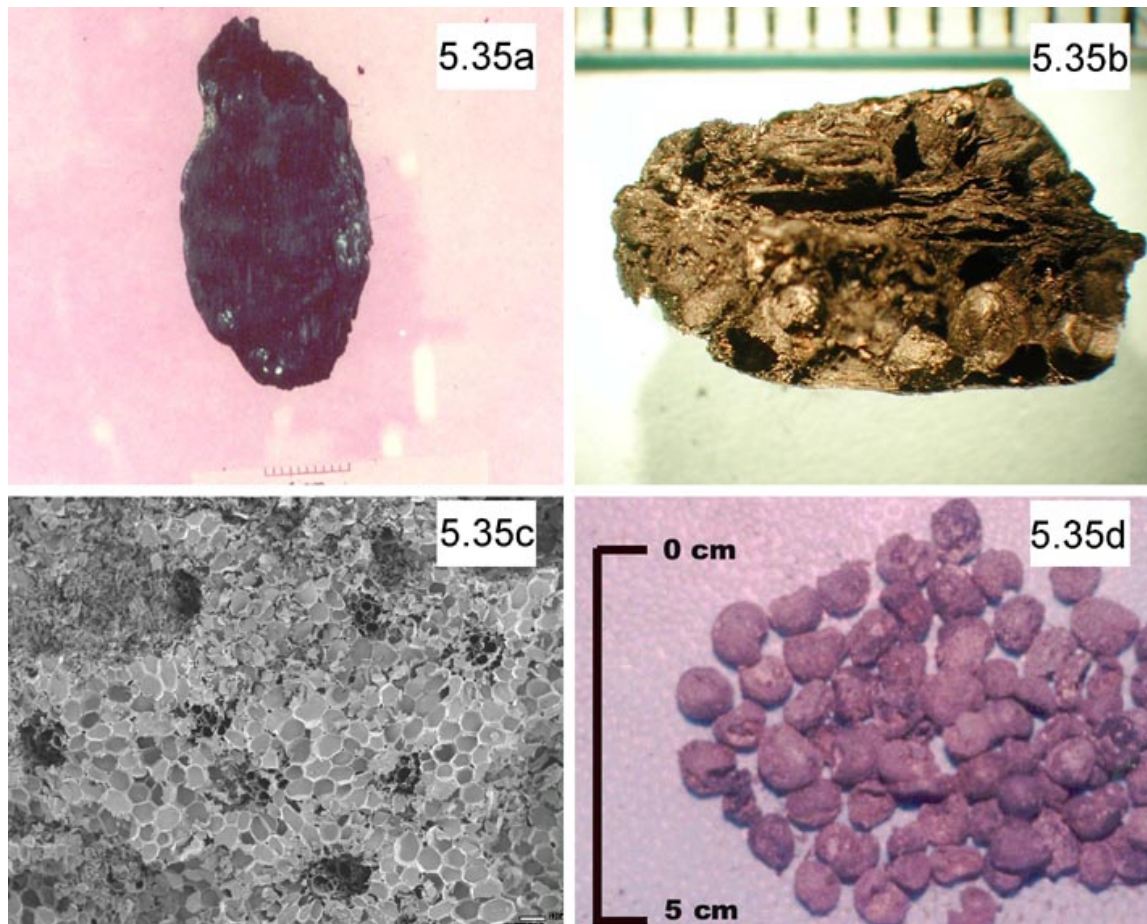


Figure 5.35: Maize remains from Barton Creek Cave, Feature 23. 5.35a: Maize ear with intact husk (Scale bar= 1cm). 5.35b: Underdeveloped maize ear (Marks indicate 1mm). 5.35c: SEM of maize stem in cross-section X50. 5.35d: Maize kernels.

underdeveloped, a characteristic of ears at the basal region of the maize plant. Other ears have the leaf sheaths, or husks, intact. The fact that many parts of the maize plant are represented in the samples from Feature 23 suggests that entire plants were deposited. Nine specimens of complete or nearly complete cobs from Feature 23 were selected for morphological analysis. Due to differential preservation of the maize, measurements made on some specimens may not have been possible on others.

Maize remains from Feature 23 and Bone Cluster 1 are morphologically similar despite minor variation in maize measurements, suggesting that they may be from taxonomically related maize types. Cobs from Feature 23 are short, narrow, and tapered with an average row number of 10.33. Feature 23's kernels are isodiametric with rounded, non-dented crowns. Kernels from Bone Cluster 1 are also isodiametric with rounded, non-dented crowns. The fragmented condition of Bone Cluster 1's maize prevented cob width and length measurements. Row number for Bone Cluster 1's maize was estimated based on cupule and kernel angles. The average cupule angle for Bone Cluster 1's maize is 72.43°. The ideal cupule angle for a ten-rowed maize is 72°. The variation

from the norm is minimal, indicating that the cupules are from ten-rowed cobs. Angle measurements on Bone

Cluster 1's kernels also suggest that they are from a ten-rowed maize. The average kernel angle from Bone Cluster 1 is 35.33°, close to the ideal kernel angle for a ten-rowed maize, 36°. Comparisons between cupule measurements of maize from Feature 23 and Bone Cluster 1 demonstrate substantial affinities. Figure 5.36 plots the relationship of cupule width and cupule length of individual maize specimens from both deposits, and Figure 5.37 shows the distribution of cupule width and cupule wing width. Both figures reveal considerable overlap in quantitative measurements, indicating similarity between maize specimens from both archaeological deposits. More overlap is present in comparisons of cupule width and cupule length (Figure 5.36) than is evident in comparisons of cupule width and cupule wing width (Figure 5.37). Maize from Bone Cluster 1 has wider cupules and wider cupule wings. On the other hand, there is much variation between individual specimens, and the reduction of overlap by Feature 23's specimens in Figure 5.37 is probably due to the small sample size. Based on the present data, then, it appears that the maize from both Feature 23 and Bone Cluster 1

Table 5.10: Morphological measurements of maize from Barton Creek Cave. Spec= specimen, C= circular, T= tapered, Cup= cupule, Kern= kernel, len= length, CF= cob fragment, <sup>1</sup>= husk intact [difficult to obtain all measurements], <sup>2</sup>= fragmentary [not used to calculate overall mean], <sup>3</sup>= not affected by shrinking, <sup>4</sup>= estimated based on angle measurements.

| Provenience   | Spec #          | Cupule Width | Cupule Length | Cupule Wing | Glume Width | Rachis Dia. | Cob Dia. Max | Cob X-sec Shape | Cob Length         | Ear Dia.          | Long Shape | Row #          | Kern Width | Kern Len | Kern Thick |
|---------------|-----------------|--------------|---------------|-------------|-------------|-------------|--------------|-----------------|--------------------|-------------------|------------|----------------|------------|----------|------------|
| F23, CC3      | 1a              | 6.88         | 2.26          | 0.9         | 2.27        | 11.21       | -            | C               | 50.36              | 30.02             | T          | 10             | 7.71       | 8.86     | 4          |
| F23, CC3      | 1b              | 8.32         | 1.68          | 1.18        | 2.12        | 11.76       | 15.4         | C               | 35.4               | -                 | T          | 10             | 8.32       | 8.48     | 4.29       |
| F23, CC3      | 1c <sup>1</sup> | -            | -             | -           | -           | -           | -            | C               | 49.98              | 23.38             | T          | 10             | -          | -        | -          |
| F23, CC1      | 1d              | 5.56         | 2.4           | 0.98        | 2.1         | -           | 19.25        | -               | -                  | 29.12             | -          | -              | 6.8        | 6.86     | 5.2        |
| F23, CC6      | 1e              | -            | -             | -           | 2.75        | 11.88       | 17.6         | C               | 21.82 <sup>2</sup> | -                 | T          | 10             | -          | -        | -          |
| F23, CC6      | 1f              | 6.33         | 2.2           | 0.94        | 2.6         | 12.16       | 16.04        | C               | 21.42 <sup>2</sup> | -                 | T          | 10             | -          | -        | -          |
| F23, CC6      | 1g              | -            | -             | -           | -           | -           | -            | C               | -                  | 19.2 <sup>2</sup> | -          | -              | 7.38       | 8.44     | 5.7        |
| F23, CC6      | 1h              | -            | -             | -           | 2.41        | 10.68       | -            | -               | -                  | -                 | -          | -              | 7.46       | 7.08     | 5.01       |
| F23, Screen   | 1i              | 4.72         | 2.1           | 1.28        | 1.84        | -           | 15.7         | C               | 31.4               | -                 | T          | 12             | 7.26       | 6.01     | 4.04       |
| Average       |                 | 6.36         | 2.13          | 1.06        | 2.3         | 11.54       | 16.8         | -               | 41.79              | 27.51             | -          | 10.33          | 7.49       | 7.62     | 4.71       |
| 20%Correction |                 | 7.63         | 2.56          | 1.27        | 2.76        | 13.85       | 20.16        | -               | 50.15              | 33.01             | -          | - <sup>3</sup> | 8.99       | 9.14     | 5.65       |

| Provenience   | Spec # | Cupule Width | Cupule Length | Cupule Wing | Glume Width | Cupule Angle | Kernel Width | Kernel Length | Kernel Thick | Kernel Angle | Row # <sup>4</sup> |
|---------------|--------|--------------|---------------|-------------|-------------|--------------|--------------|---------------|--------------|--------------|--------------------|
| L8, AB, BC1   | Cup. 1 | 6.7          | 2.12          | 1.02        | -           | 73°          | -            | -             | -            | -            | 10                 |
|               | Cup. 2 | 5.87         | 2.44          | 0.94        | -           | 72°          | -            | -             | -            | -            | 10                 |
|               | Cup. 3 | 7.4          | 1.75          | 1.14        | -           | 73°          | -            | -             | -            | -            | 10                 |
|               | Cup. 4 | 6.92         | 2.43          | 1.06        | -           | 74°          | -            | -             | -            | -            | 10                 |
|               | Cup. 5 | 5.42         | 2.02          | 0.88        | -           | 71°          | -            | -             | -            | -            | 10                 |
|               | Cub. 6 | 7.22         | 1.98          | 1.24        | -           | 72°          | -            | -             | -            | -            | 10                 |
|               | CF1    | 7.88         | 2.04          | 1.16        | 2.04        | 72°          | -            | -             | -            | -            | 10                 |
|               | Kern 1 | -            | -             | -           | -           | -            | 7.04         | 6.88          | 4.4          | 34°          | 10                 |
|               | Kern 2 | -            | -             | -           | -           | -            | 6.78         | 6.6           | 4.46         | 37°          | 10                 |
|               | Kern 3 | -            | -             | -           | -           | -            | 7.48         | 7.18          | 5.12         | 35°          | 10                 |
| Average       |        | 6.77         | 2.11          | 1.06        | 2.04        | 72.43°       | 7.1          | 6.87          | 4.66         | 35.33°       | 10                 |
| 20%Correction |        | 8.12         | 2.53          | 1.27        | 2.45        | -            | 8.52         | 8.24          | 5.59         | -            | -                  |

form an affinal group, probably a taxonomically related maize type. As at Actun Chapat, comparisons between maize from Barton Creek Cave and other Maya sites are difficult because morphological data from other sites are sparse. In addition, the types of measurements made on maize usually differ depending on the site. Thus, available metric data for comparisons may not be the most useful in distinguishing affinities between archaeological maize assemblages. Nonetheless, limited comparisons can be made.

Barton Creek Cave's maize remains have little resemblance to maize from Cuella (Figure 5.38). Cupule length for Barton Creek Cave maize falls into the range of Cuella's Formative period maize; in fact, Barton Creek Cave's cupules are shorter than some of Cuella's specimens. Cupules from Barton Creek Cave are much wider, however. The increase in cupule width and the compaction of cupule length has been noted as an

evolutionary trend in maize domestication (Galinat 1970). Thus, the difference between the short, wide cupules of Barton Creek Cave's maize and the short, narrow cupules of Cuella's maize is possibly a product of morphological change from the Formative period to the Late Classic period.

Although row numbers are helpful in associating ancient maize remains with either lowland or highland varieties of extant maize, as was the case with Actun Chechem Ha's maize, they are not useful in distinguishing maize from different time periods. Low row number is a constant attribute of maize from Maya sites from the Formative period to the Late Classic period. The row number of Barton Creek Cave's maize, 10, is close to row numbers recorded from Late Classic period maize from Copán (12-13) (Lentz 1991) and Wild Cane Cay (12) (McKillop 1994), Early Classic period maize from Cerén (13.1) (Lentz et al. 1996a), and Formative period maize

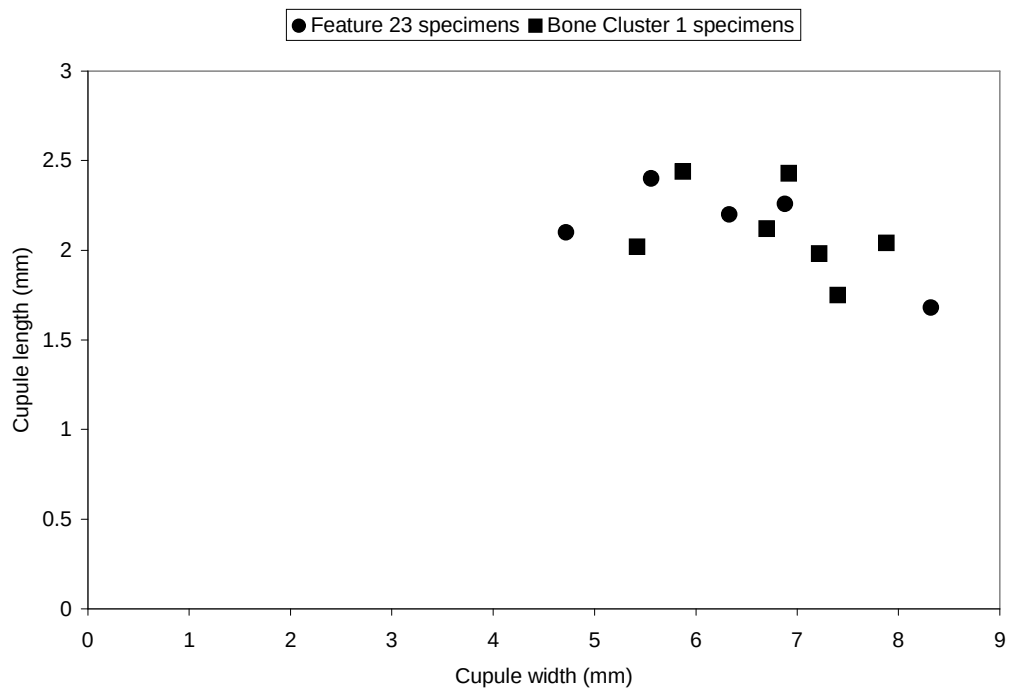


Figure 5.36: Comparison between maize from Feature 23 and Bone Cluster 1 based on uncorrected cupule width and cupule length (n= 12)

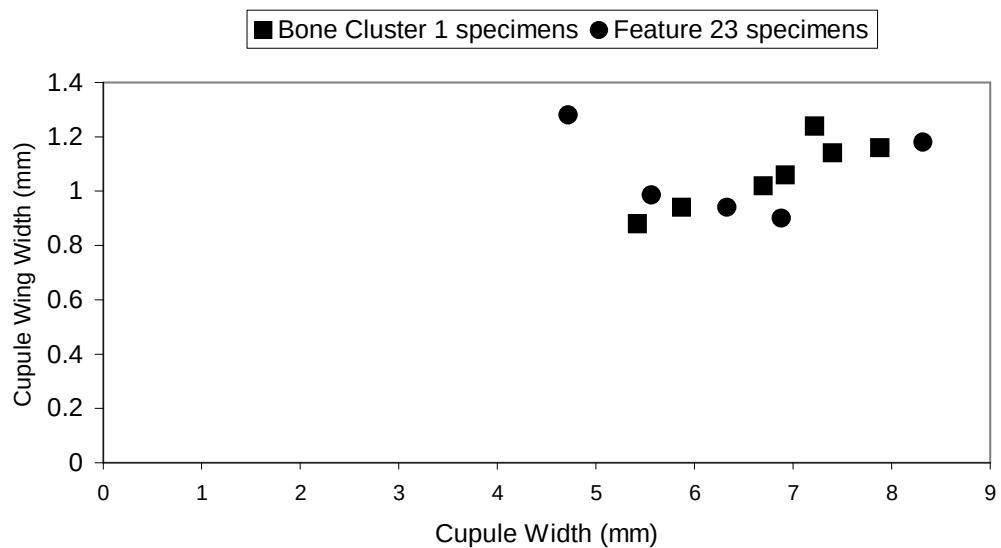


Figure 5.37: Comparison between maize from Feature 23 and Bone Cluster 1 based on cupule width and cupule wing width (n= 12).

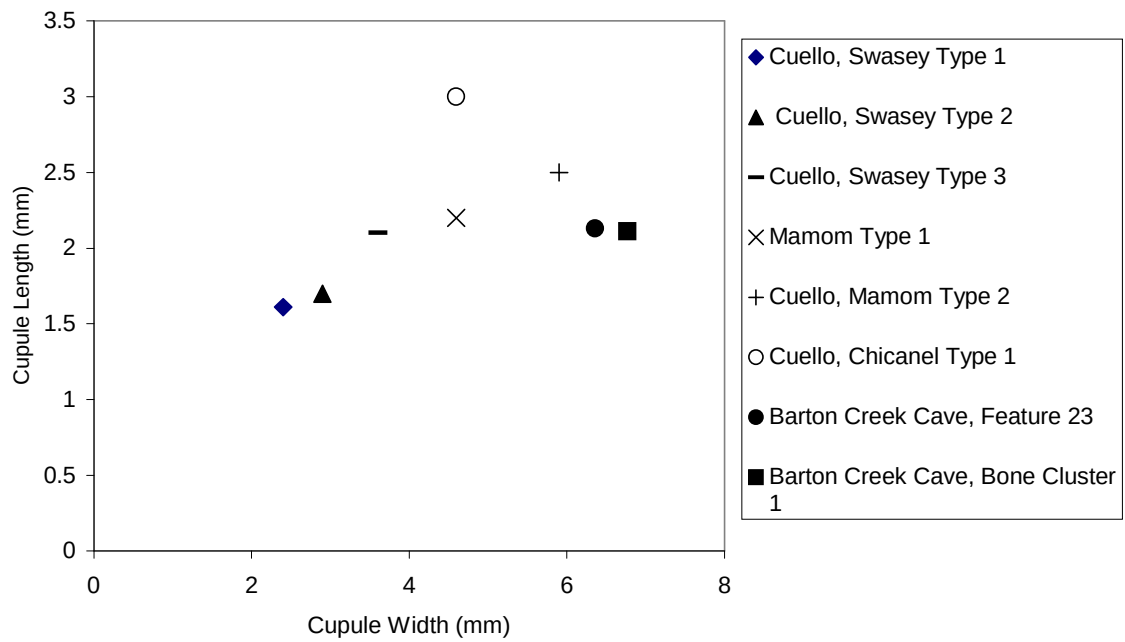


Figure 5.38: Comparisons between maize from Barton Creek Cave and Cuello based on uncorrected cupule width and cupule length.

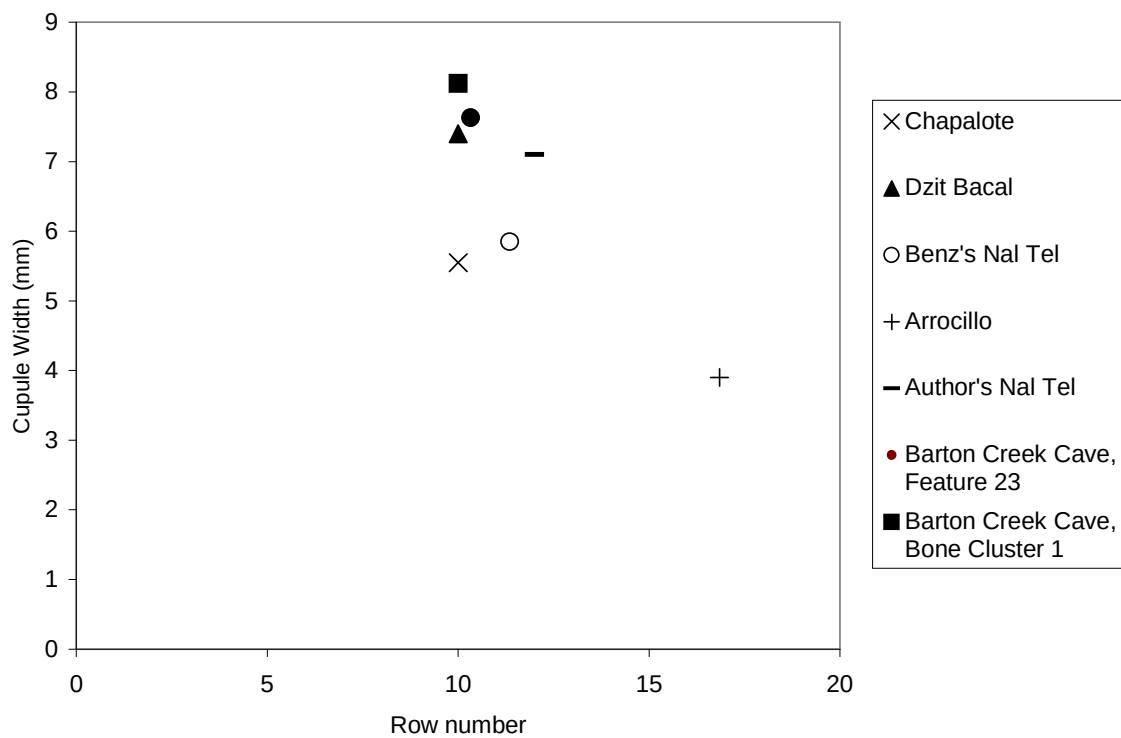


Figure 5.39: Comparison between modern and Barton Creek maize based on row number and cupule width.



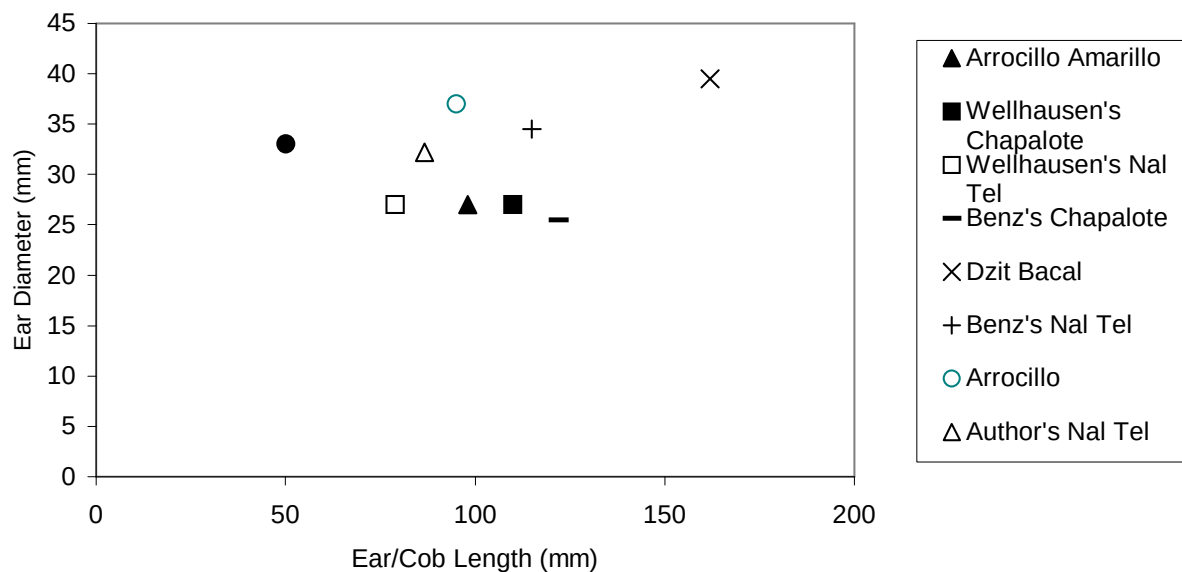


Figure 5.40: Comparison between modern and Barton Creek maize based on ear/cob length and ear diameter.

from Cuello (10-12.9) (Miksicek et al. 1981). Unfortunately, no internal cob measurements are provided for maize from Late Classic period Maya sites, preventing a more thorough comparison of Barton Creek Cave's maize with other Late Classic period maize.

Morphological data from Barton Creek Cave's maize were compared with those of extant maize races. Because of the remarkable preservation of Barton Creek Cave's maize, internal and external maize ear characteristics can be compared. In the first case, row number and cupule width from Barton Creek Cave's maize is compared with the same features from Chapalote, Nal Tel, Dzit Bacal, and Arrocillo races (Figure 5.39). The second comparison involves only external characteristics, namely ear/cob length and ear diameter (Figure 5.40). In addition to morphological data on modern maize provided by the author and by Benz (1986), metric data on external ear features from Wellhausen et al. (1952) are used for the second comparison. Comparative maize races from Wellhausen et al. that are compared include Chapalote, Nal Tel, and Arrocillo Amarillo, which is the same as Benz's (1986) Arrocillo. Measurements from Barton Creek Cave have been inflated 20% to compensate for post-depositional shrinking. Only maize from Feature 23 is used for the second evaluation because maize remains from Bone Cluster 1 lack external features. This situation should have little impact on the analysis because maize from Feature 23 and Bone Cluster 1 appear to be closely related maize types.

By comparing row number and cupule width, maize remains from Barton Creek Cave cluster closely with modern lowland varieties (Figure 5.39). Morphologically, Barton Creek's maize remains more closely resemble Benz's (1986) description of lowland Dzit Bacal than

Chapalote or Nal Tel. When ear/cob length and ear diameter of Barton Creek's maize from Feature 23 is compared to extant races, however, a different pattern emerges (Figure 5.40). Barton Creek's maize shows the least similarity to Dzit Bacal. Cobs and ears from Barton Creek Cave are shorter than those of modern races, a factor that prevents Barton Creek's maize clustering with modern types. On the other hand, out of all the modern races included in bi-variate analysis, the diameter of Barton Creek Cave's maize ears is closest to diameters of both the author's and Benz's (1986) Nal Tel. The dissimilarity from Arrocillo, the highland variety, is substantial.

**Textile Fragment.** A small, carbonized textile fragment and five individual plied yarns were recovered from Feature 23 (Table 5.11, Figures 5.41 and 5.42). The fragment is approximately 5 cm long and approximately 3 cm wide. Scanning electron microscopy revealed long, narrow, uni-cellular fibers characteristic of cotton (*Gossypium* sp.) (Figures 5.42c-d). Distinguishing between the warp and weft elements is not possible because end or side selvage treatments are not preserved. As a result, the two elements are designated here as "A" and "B." The yarns of both the A and B elements are Z-spun and S-plied. "Z" and "S" refer to the direction of twist of spun and plied yarns according to whether the spiral of the yarn conforms to the central slant of the letters "Z" or "S" when held vertically. The five individual yarns are also Z-spun and S-plied, suggesting that they may be part of the same cloth. Thus, both warps and wefts are composed entirely of Z-spun, S-plied yarns (Figure 5.42b). Diameter measurements and the number of twists per 1 cm of warp and weft elements are useful in distinguishing tightness of twist and overall textural differences in the cloth. The A elements are looser with

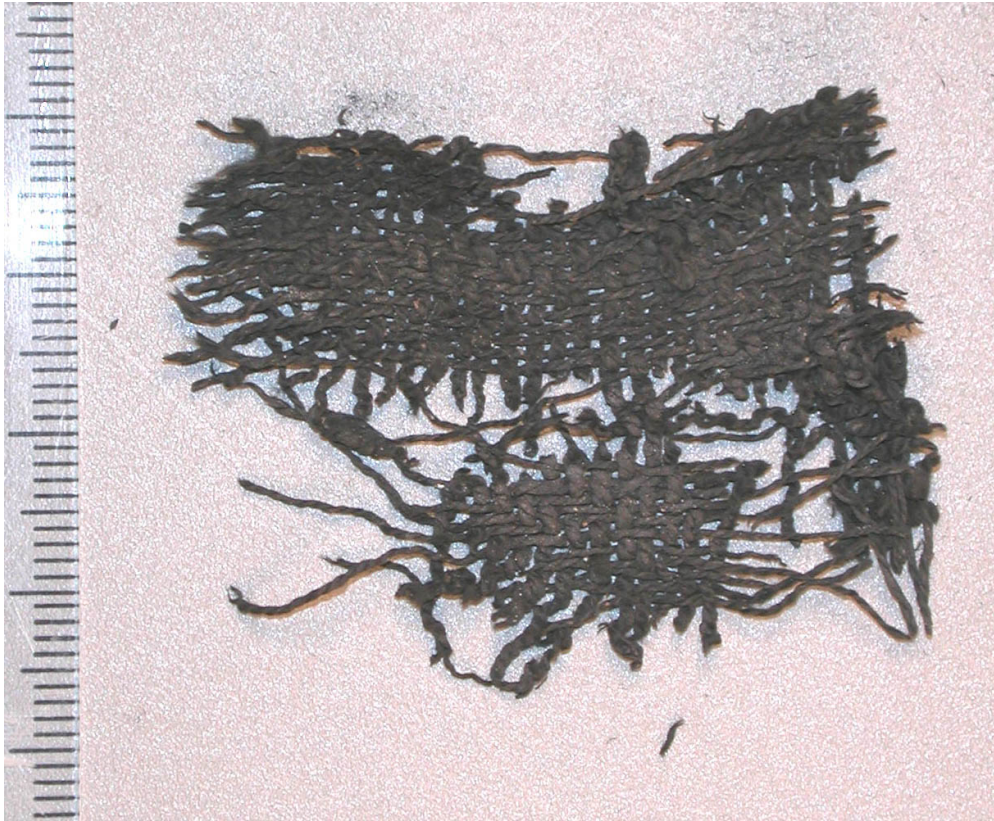
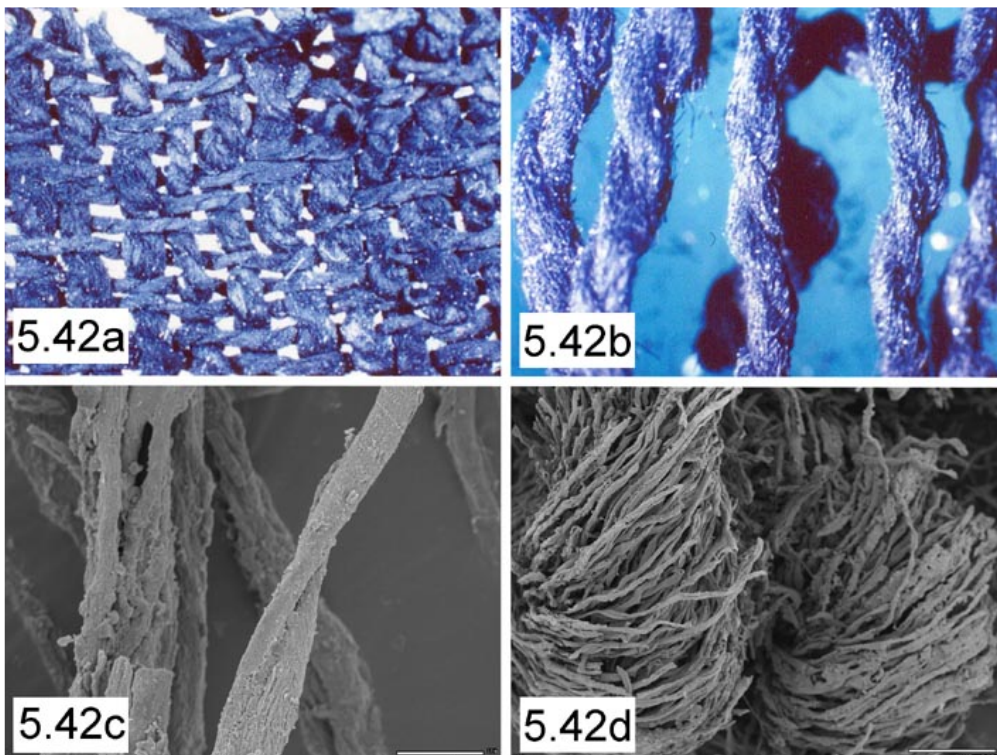


Figure 5.41: Textile fragment from Barton Creek Cave, Feature 23 (20038-002). A elements are horizontal and B elements are vertical in the image.



Figures 5.42: Different aspects of the textile fragment from Barton Creek Cave. 5.42a: Close up of textile showing twilled weaving pattern, B elements are vertical and A elements are horizontal in image. 5.42b: Close up of A elements showing the Z-spun, S-ply yarns. 5.42c: SEM of the textile's cotton (*Gossypium* sp.) fibers X2000. 5.42d: SEM of spun cotton fibers X200.

Table 5.11: List of measurements recorded for the textile fragment from Barton Creek Cave. Elements refers to the complete, S-plied yarns whereas components refers to the Z-spun singles that compose the S-plied yarns.

|                |              |            |                    |            |
|----------------|--------------|------------|--------------------|------------|
|                | A Elements   | B Elements | Total Elements/cm2 |            |
| # Elements/cm2 | 14           | 8          | 22                 |            |
|                | A Component  | A Elements | B Component        | B Elements |
| Diameters (mm) | 0.38         | 0.56       | 0.49               | 1.04       |
|                | A Components | A Elements | B Components       | B Elements |
| Yarn Types     | Z-spun       | S-plied    | Z-spun             | S-plied    |
|                | A Elements   | B Elements |                    |            |
| # Twists/cm    | 12           | 12         |                    |            |
|                | A Elements   | B Elements |                    |            |
| Angle of Twist | 20°          | 55°        |                    |            |

roughly 0.56 mm yarns and 12 turns/cm. The B elements have a slightly tighter twist with about 1.04 mm yarns and 12 turns/cm (Table 5.11). The weaving technique used in the Barton Creek textiles appears to be inconsistent, a factor that may be the result of preservation or poor manufacture (Figure 5.42a). Overall, the primary structure conforms predominantly to a 2/2 twill pattern.

**Other Macrofloral Remains.** In addition to the material discussed above, a number of other archaeobotanical remains were recovered. Identification of many of these specimens was difficult due to their fragmentary condition and lack of comparative material. Among the material still unidentified are carbonized residues, four dicot floral buds, dicot rind fragments, three unknown disseminules (one is uncarbonized and likely intrusive), and two larger, unknown seeds. One group of remains of particular interest is a substantial amount of carbonized herbaceous shoots from Feature 23. The shoot remains are morphologically distinct from the maize shoots from the same feature. The shoots are from an unknown genus. 15.76 g of shoots were recovered from Feature 23. Two wild grape (*Vitis tiliifolia*) seeds were found in two archaeological deposits (Figure 5.43). Although the seeds are carbonized, it is possible that they were deposited in the cave through natural means and were burned with culturally deposited botanical material. Finally, one

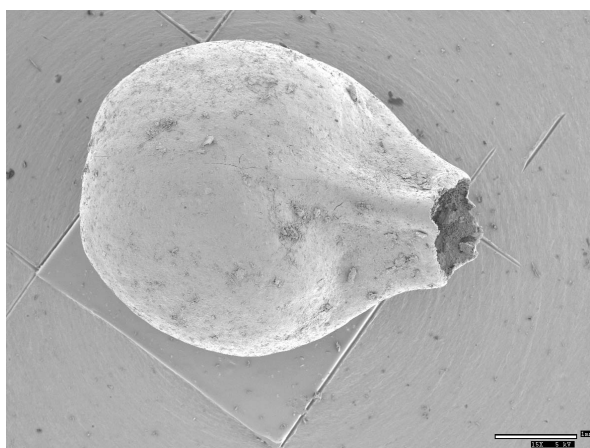


Figure 5.43: SEM of *Vitis tiliifolia* seed X15 (10058-002).

achene of the Compositae family was recovered. Because only one achene was found in Barton Creek Cave, its prehistoric significance is uncertain. It is possible that the achene is the remnant of an intentionally deposited herbaceous flora that disintegrated during firing leaving only the achenes.

**Feature 23.** Feature 23 is the most notable deposit encountered in Barton Creek Cave archaeobotanically. Feature 23 is a large hearth feature, approximately 4 x 6 m, located on Ledge 2, Area C (Figure 5.44, see also Figure 4.13). Like other archaeological deposits at Barton Creek Cave, it is stratigraphically shallow. Unlike other contexts, Feature 23 was covered by rocks that had spalled off the cave wall and ceiling. This factor protected the feature and resulted in remarkably well-preserved organic remains.

Almost all domesticated plants found at Barton Creek Cave are from Feature 23. Maize from the feature includes kernels; complete and fragmented cobs; entire ears, some with leaf sheaths or husks intact; underdeveloped cobs that appear to be from the basal portion of the maize plant; and maize stem fragments. The association of many different parts of the mature maize plant suggests that entire maize plants were deposited in the cave.

Feature 23 was the only context at Barton Creek Cave to yield squash and chile pepper remains. Unprocessed squash and chile pepper fruits were probably deposited because both seeds and fruit fragments, rinds and calyxes, are represented in the feature. Lastly, one fragmented bean cotyledon was found in the feature.

Many genera of wood charcoal, including pine, *Theobroma* sp., *Protium*, *Byrsonima* sp., and *Zanthoxylum* sp., were recovered from Feature 23. Also, a concentration of herbaceous, grass-like shoots was found. It was not possible to determine the shoots' genus (see above).

The cotton textile fragment and the individual cotton yarns discussed above were recovered from Feature 23. The textile's association with the cultigens, particularly



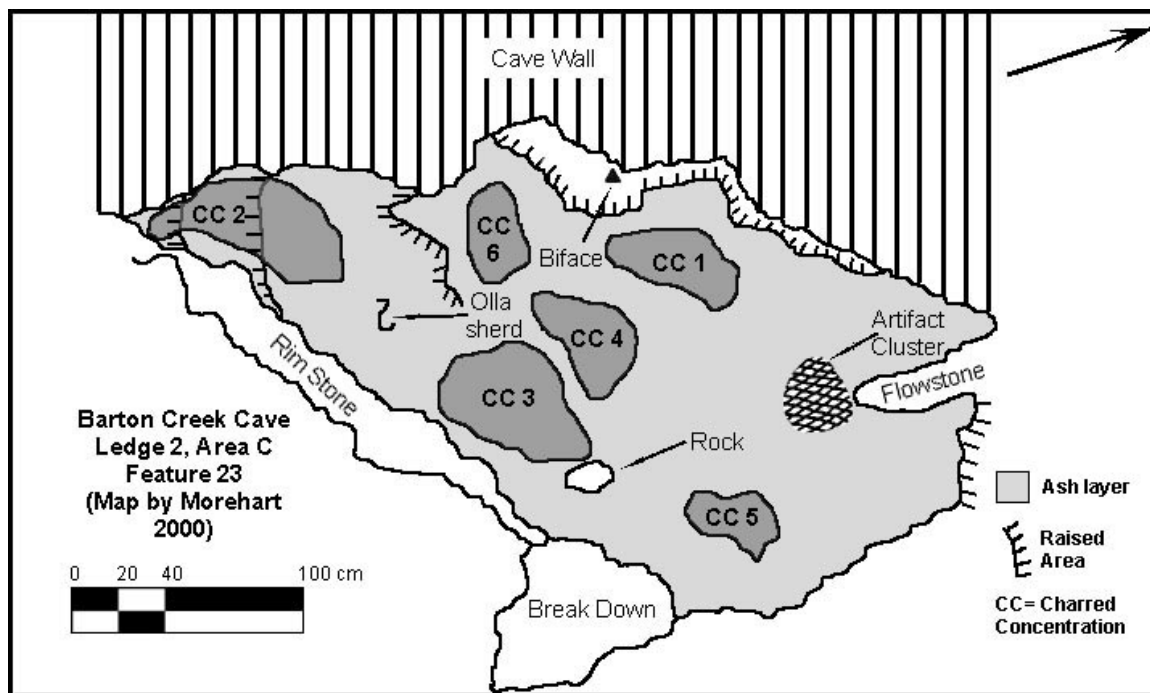


Figure 5.44: Plan map of Barton Creek Cave, Ledge 2, Area C, Feature 23.

maize, suggests that the cloth may have been used to wrap the food items prior to deposition (see Chapter 6).

Controlled archaeobotanical samples were collected from Feature 23. Much of Feature 23 was composed of a thick layer of fibrous ash with little apparent preservation. After the cave breakdown was removed, however, six well-preserved concentrations (CC 1-6) of charred material were uncovered (Figure 5.44). These areas were numbered sequentially as they were encountered, and macrofossil samples and one-liter flotation samples were collected from them. No samples were taken from CC 4. One macrofossil sample from Feature 23 is composed of material collected prior to controlled sampling and is referred to as a “general collection.” Archaeobotanical material from flotation samples and macrofossil samples are listed in Table 5.12. Maize remains have been separated into two groups, stems and ear fragments, in Table 5.12. Ear fragments refer to all material from the maize ear, including kernels, cupules, glumes, complete ears and cobs, incomplete ears and cobs, and underdeveloped cobs (see Table 5.9 and Appendix A for a complete list of parts of the maize ear recovered from Feature 23).

The controlled sampling of Feature 23 permits the analysis of spatial concentrations of archaeobotanical remains (see Figure 5.44). CC 1, CC 3, and CC 6 are located more in the central area of Feature 23, though CC 1 and CC 6 are along the western cave wall, and CC 3 is along the eastern edge of the feature. CC 2 is the southern most concentration sampled, located where Feature 23 tapers off between the western cave wall and a rim stone dam. CC 5 is a small concentration at the northeastern edge of Feature 23.

Spatial patterning in the plant remains from one-liter flotation samples from Feature 23 suggests that the food offerings were oriented toward the western cave wall flanking Feature 23. A higher diversity in domesticates was recovered from CC 1 and CC 6 along the west wall. These are the only two deposits that yielded domesticates other than maize. CC 1 contained *Cucurbita pepo* seeds. CC 6 yielded *Cucurbita* sp. rind fragments, *C. pepo* and *C. moschata* seeds, a single bean (*Phaseolus* sp.), and chile pepper (*Capsicum annum*) remains. The other charred concentrations contained maize only.

Spatial analysis of the weights of maize stems and ear fragments and of the weight of the unknown genus of weedy shoots from one-liter flotation samples supports the interpretation that the food offerings were oriented toward the west (Figure 5.45). Maize remains were found in all charred concentrations. The genus of weedy, grass-like stems was also common; it was recovered from all CC’s except CC 3. Despite the regular occurrence of both taxa, their weights are spatially variable. The relative importance of maize ear fragments is greater from CC 1 and CC 6 than the other concentrations measured by weight. CC 1 yielded 5.56 grams of maize ear fragments, and CC 6 yielded 7.17 grams. The other CC’s contained substantially less maize ear fragments. CC 3 yielded the greatest amount of maize stem fragments, 24.01 grams. The dominance of maize stem fragments from CC 3, located on the eastern side of Feature 23, suggests that the lower, basal portions of the maize plants may have been placed there. The ear-bearing portions of the maize plant were oriented toward the west where their remains were dominant in the western charred concentrations, CC 1 and CC 6. Interestingly, cotton textile remains were only found in CC 3 and CC 1, providing support for east to west continuity—especially if the cloth had been used to wrap the maize plants prior to deposition.

Table 5.12: Archaeobotanical remains from Flotation and Macrofossil samples recovered from Feature 23, Barton Creek Cave. Prov= provenience, I.D.= specimen ID number.

| Prov and I.D.                                   | Flotation Samples               |        | Macrofossil Samples             |        |
|-------------------------------------------------|---------------------------------|--------|---------------------------------|--------|
|                                                 | Plant Name and Part             | Weight | Plant Name and Part             | Weight |
| Feature 23, CC 1<br>I.D. 10064-10065,<br>20044  | <i>Zea mays</i> stems           | 6.47   | <i>Zea mays</i> stems           | 3.65   |
|                                                 | <i>Zea mays</i> ear fragments   | 5.6    | <i>Zea mays</i> ear fragments   | 3.72   |
|                                                 | <i>Cucurbita pepo</i> seeds     | 0.12   | Weedy shoots                    | 0.29   |
|                                                 | <i>Gossypium</i> sp. yarns      | > 0.01 | <i>Pinus</i> sp. charcoal       | 0.65   |
|                                                 | Weedy shoots                    | 1.17   | <i>Zanthoxylum</i> sp. charcoal | 0.4    |
|                                                 | <i>Pinus</i> sp. charcoal       | 1      |                                 |        |
|                                                 | <i>Zanthoxylum</i> sp. charcoal | 1.68   |                                 |        |
|                                                 | Hardwood Charcoal               | 0.46   |                                 |        |
|                                                 | Dicot floral bud                | 0.01   |                                 |        |
|                                                 | Unknown seed                    | 0.01   |                                 |        |
| Feature 23, CC 2<br>I.D. 10066-10067,<br>20042  | <i>Zea mays</i> stems           | 0.91   | <i>Zea mays</i> stems           | 0.29   |
|                                                 | <i>Zea mays</i> ear fragments   | 2.68   | <i>Zea mays</i> ear fragments   | > 0.01 |
|                                                 | Weedy shoots                    | 4.11   | Unknown fibrous ash             | 7.65   |
|                                                 | <i>Pinus</i> sp. charcoal       | 0.36   |                                 |        |
|                                                 | <i>Zanthoxylum</i> sp. charcoal | 0.83   |                                 |        |
| Feature 23, CC 3<br>I.D. 10062-10063,<br>20038  | <i>Zea mays</i> stems           | 24.01  | <i>Zea mays</i> stems           | 1.39   |
|                                                 | <i>Zea mays</i> ear fragments   | 1.05   | <i>Zea mays</i> ear fragments   | 10.79  |
|                                                 | <i>Protium</i> sp. charcoal     | 7.69   | <i>Protium</i> sp. charcoal     | 26.49  |
|                                                 | <i>Gossypium</i> sp. textile    | -      | Rubiaceae charcoal              | 0.9    |
|                                                 | Unknown residue                 | 6.11   | Hardwood charcoal               | 0.37   |
| Feature 23, CC 5<br>I.D. 20038a                 | <i>Zea mays</i> ear frags       | 0.02   | No sample                       | -      |
|                                                 | Weedy shoots                    | 6.11   |                                 |        |
|                                                 | Hardwood charcoal               | 0.07   |                                 |        |
| Feature 23, CC 6<br>I.D. 10067b, 20043          | <i>Zea mays</i> stems           | 0.82   | <i>Zea mays</i> stems           | 0.43   |
|                                                 | <i>Zea mays</i> ear fragments   | 7.17   | <i>Zea mays</i> ear fragments   | 2.62   |
|                                                 | <i>Cucurbita moschata</i> seeds | 0.02   | <i>Cucurbita</i> sp. rinds      | 0.23   |
|                                                 | <i>Cucurbita pepo</i> seeds     | 0.03   | Weedy shoots                    | 3.58   |
|                                                 | <i>Cucurbita</i> sp. rinds      | 0.29   | <i>Pinus</i> sp. charcoal       | 0.08   |
|                                                 | <i>Phaseolus</i> sp. seed       | 0.01   | <i>Protium</i> sp. charcoal     | 3.38   |
|                                                 | <i>Capsicum annuum</i>          | 0.07   | <i>Theobroma</i> sp. charcoal   | 0.49   |
|                                                 | <i>Vitis tiliifolia</i> seed    | > 0.01 |                                 |        |
|                                                 | Dicot floral buds               | 0.03   |                                 |        |
|                                                 | Weedy shoots                    | 0.5    |                                 |        |
|                                                 | <i>Pinus</i> sp. charcoal       | 2.01   |                                 |        |
|                                                 | <i>Zanthoxylum</i> sp. charcoal | 3.86   |                                 |        |
| Feature 23, general<br>collection<br>I.D. 10068 | No Sample                       | -      | <i>Zea mays</i> stems           | 2.1    |
|                                                 |                                 |        | <i>Zea mays</i> ear fragments   | 5.46   |
|                                                 |                                 |        | <i>Pinus</i> sp. charcoal       | 0.33   |
|                                                 |                                 |        | <i>Byrsonima</i> sp. charcoal   | 2.4    |
|                                                 |                                 |        | <i>Theobroma</i> sp. charcoal   | 0.13   |
|                                                 |                                 |        | Burseraceae charcoal            | 2.18   |
|                                                 |                                 |        | Hardwood charcoal               | 4.73   |

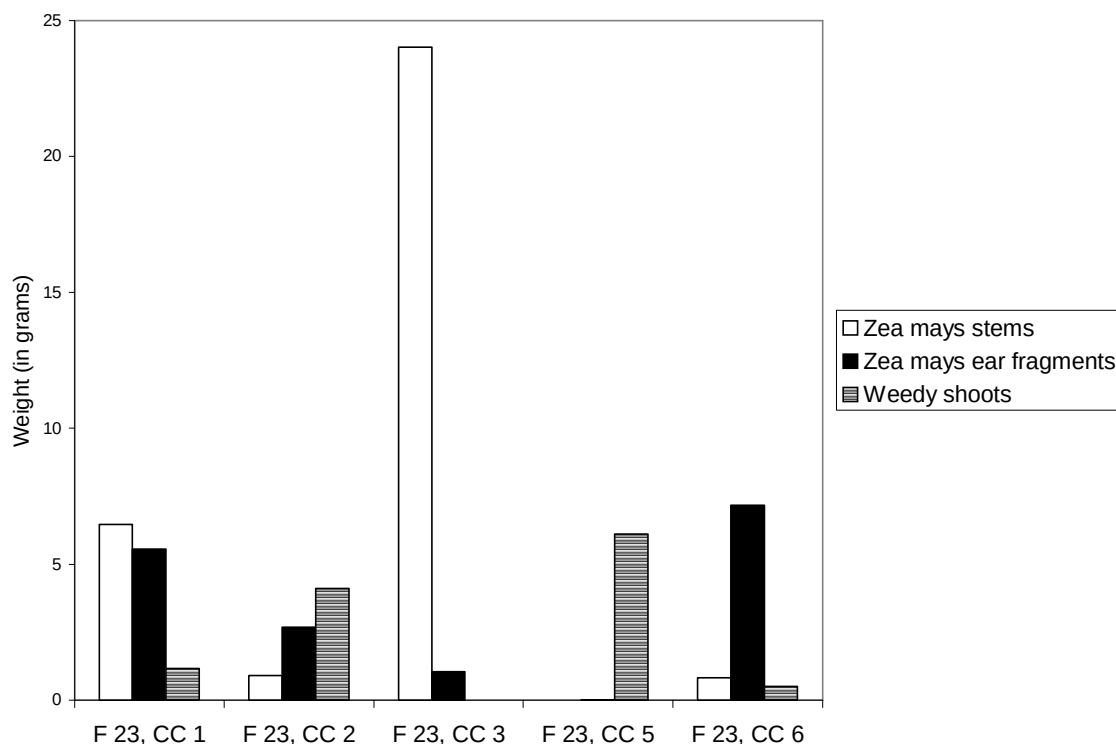


Figure 5.45: Distribution of maize stems, maize ear fragments, and the shoots of the unknown weedy genus from charred concentrations (CC's) from Feature 23, Barton Creek Cave.

### Barton Creek Cave vs. Comparative Sample

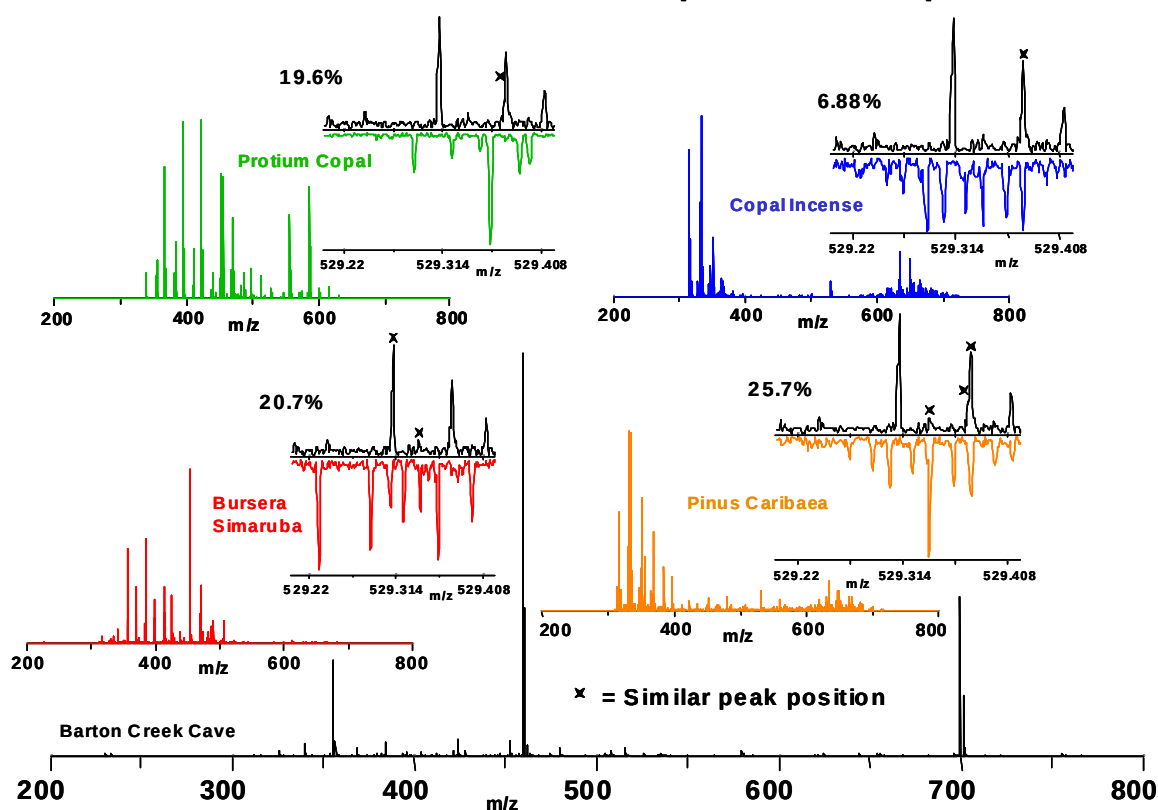


Figure 5.46: Results of Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) conducted on a carbonized residue sample from Bone Cluster 25 (BC 25) (10055-002).

Table 5.13: Archaeobotanical remains recovered from Actun Nak Beh, Cayo District, Belize. E= entrance, CH= chamber, U= excavation unit, L= excavation level, ext= unit extension, LC= Late Classic period, EC= Early Classic period, – = unquantified, \*= uncarbonized.

| Provenience                         | Scientific Name                   | Part              | Weight | # | Time Period | ID #                         |
|-------------------------------------|-----------------------------------|-------------------|--------|---|-------------|------------------------------|
| E1, U1, L5                          | <i>Pinus</i> sp.                  | Charcoal          | 4.65   | - | LC          | 10010,<br>10011,<br>20004    |
|                                     | <i>Andira inermis</i>             | Charcoal          | 1.25   | - |             |                              |
|                                     | <i>Attalea cohune</i>             | Endocarp          | 0.27   | - |             |                              |
|                                     | Meliaceae                         | Charcoal          | 0.01   | - |             |                              |
|                                     | Combretaceae                      | Charcoal          | 0.01   | - |             |                              |
|                                     | Unknown                           | Residue           | 0.04   | - |             |                              |
| E1, U1, L6                          | <i>Pinus</i> sp.                  | Charcoal          | 0.56   | - | LC          | 10012,<br>10013<br>20005     |
|                                     | Hardwood                          | Charcoal          | 0.25   | - |             |                              |
|                                     | Dicot                             | Charcoal          | 0.32   | - |             |                              |
|                                     | <i>Byrsonima</i> sp.              | Charcoal          | 0.13   | - |             |                              |
|                                     | <i>Rheedia</i> sp.                | Charcoal          | 0.11   | - |             |                              |
| E1, U1ext, L6                       | <i>Pinus</i> sp.                  | Charcoal          | 1.99   | - | LC          | 10016,<br>10017              |
| E1, U1, L7                          | <i>Pinus</i> sp.                  | Charcoal          | 0.67   | - | LC          | 10014,<br>20006              |
|                                     | Leguminosae                       | Charcoal          | 0.08   | - |             |                              |
|                                     | <i>Byrsonima</i> sp.              | Charcoal          | 0.21   | - |             |                              |
|                                     | <i>Attalea cohune</i>             | Endocarp          | 0.01   | - |             |                              |
|                                     | Unknown                           | Residue           | 0.54   | - |             |                              |
| E1, U1ext. L7                       | <i>Pinus</i> sp.                  | Charcoal          | 2.4    | - | LC          | 10018,<br>20007              |
|                                     | Meliaceae                         | Charcoal          | 0.01   | - |             |                              |
|                                     | <i>Byrsonima</i> sp.              | Charcoal          | 6.87   | - |             |                              |
|                                     | Poaceae                           | Caryopsis         | > 0.01 | 1 |             |                              |
| E1, U1, L8                          | <i>Pinus</i> sp.                  | Charcoal          | 0.28   | - | LC          | 10015                        |
| E1, U1ext, L8 (SW & SE)<br>Burial 2 | <i>Pinus</i> sp.                  | Charcoal          | 1.19   | - | LC          | 10019                        |
|                                     | c.f. Rosaceae                     | Fruit pit         | 0.78   | 1 |             |                              |
| E1, U1ext, L8, Burial 2             | <i>Pinus</i> sp.                  | Charcoal          | 25.55  | - | LC          | 10020-<br>10022(a),<br>20008 |
|                                     | <i>Byrsonima crassifolia</i>      | Pits, charcoal    | 2.08   | 3 |             |                              |
|                                     | <i>Aspidosperma</i> sp.           | Charcoal          | 0.51   | - |             |                              |
|                                     | <i>Persea</i> sp.                 | Charcoal          | 0.61   | - |             |                              |
|                                     | <i>Attalea cohune</i>             | Endocarp          | 0.02   | - |             |                              |
|                                     | <i>Cassia</i> sp.                 | Charcoal          | 0.32   | - |             |                              |
|                                     | c.f. <i>Hymenaea coubaril</i>     | Charcoal          | 1.5    | - |             |                              |
|                                     | c.f. <i>Alvaradoa amorphoides</i> | Charcoal          | 0.12   | - |             |                              |
|                                     | Meliaceae                         | Charcoal          | 0.58   | - |             |                              |
|                                     | Combretaceae                      | Charcoal          | 1.23   | - |             |                              |
|                                     | Moraceae                          | Charcoal          | 0.02   | - |             |                              |
|                                     | Compositae                        | Achene            | > 0.01 | 2 |             |                              |
|                                     | Euphorbiaceae ?                   | Parenchyma tissue | 0.01   | - |             |                              |
|                                     | Hardwood                          | Charcoal          | 0.13   | - |             |                              |
|                                     | Dicot                             | Charcoal          | 0.95   | - |             |                              |
|                                     | Unknown                           | Residue           | 0.48   | - |             |                              |
| E1, U1ext, L9 (NW & NE), Burial 3   | <i>Pinus</i> sp.                  | Charcoal          | 6.97   | - | LC          | 10023,<br>10024              |
|                                     | <i>Andira inermis</i>             | Charcoal          | 0.38   | - |             |                              |

Table 5.13, cont'd

| Provenience                                 | Scientific Name                                   | Part             | Weight | # | Time Period   | ID #                     |
|---------------------------------------------|---------------------------------------------------|------------------|--------|---|---------------|--------------------------|
| E1, U1ext, L9 (NW & NE)<br>Burial 3, cont'd | Unknown (and <i>Pinus</i> sp.)                    | Residue/charcoal | 0.08   | - |               |                          |
|                                             | Unknown                                           | Residue          | 0.75   | - |               |                          |
| E1, U2, L3                                  | <i>Pinus</i> sp.                                  | Charcoal         | 0.9    | - | LC            | 10027,<br>20010          |
| E1, U2, L4                                  | Dicot<br><i>Pinus</i> sp.<br>Arecaceae            | Charcoal         | 2.52   | - | LC            | 10028,<br>10029<br>20011 |
|                                             |                                                   | Charcoal         | 0.6    | - |               |                          |
|                                             |                                                   | Endocarp         | > 0.01 | - |               |                          |
| E1, U2, L5                                  | <i>Pinus</i> sp. Combretaceae<br>Arecaceae        | Charcoal         | 0.34   | - | LC            | 10030,<br>20012          |
|                                             |                                                   | Charcoal         | 0.02   | - |               |                          |
|                                             | Dicot                                             | Endocarp         | > 0.01 | - |               |                          |
|                                             |                                                   | Charcoal         | 0.08   | - |               |                          |
| E1, U2, L7                                  | <i>Pinus</i> sp.                                  | Charcoal         | 0.18   | - | LC or earlier | 20013                    |
| CH1, U4, L1                                 | <i>Pinus</i> sp.                                  | Charcoal         | 0.75   | - | EC            | 10031                    |
| CH1, U4, L2                                 | <i>Pinus</i> sp.                                  | Charcoal         | 1.4    | - | EC            | 10032                    |
| CH1, U4, L3                                 | <i>Pinus</i> sp.                                  | Charcoal         | 0.8    | - | EC            | 10033                    |
| CH1, U6, L2                                 | <i>Pinus</i> sp.<br>Hardwood<br>Unknown           | Charcoal         | 0.41   | - |               | 20015                    |
|                                             |                                                   | Charcoal         | > 0.01 | - |               |                          |
|                                             |                                                   | Residue          | 0.22   | - |               |                          |
| CH5, U7, L2                                 | <i>Pinus</i> sp.<br>Unknown<br>Unknown<br>Poaceae | Charcoal         | 0.4    | - | EC            | 10034,<br>20016          |
|                                             |                                                   | Disseminule*     | > 0.01 | 1 |               |                          |
|                                             |                                                   | Residue          | > 0.01 | - |               |                          |
|                                             |                                                   | Caryopsis        | > 0.01 | 1 |               |                          |
|                                             |                                                   |                  |        |   |               |                          |
| CH5, U7, L3                                 | <i>Pinus</i> sp.                                  | Charcoal         | 0.54   | - | EC            | 10035                    |
| CH5, U7, L5                                 | <i>Pinus</i> sp.<br>Hardwood<br>Dicot<br>Unknown  | Charcoal         | 0.03   | - | EC or earlier | 20017                    |
|                                             |                                                   | Charcoal         | > 0.01 | - |               |                          |
|                                             |                                                   | Rind Fragments   | > 0.01 | - |               |                          |
|                                             |                                                   | Residue          | > 0.01 | - |               |                          |
| CH5, U7, L6                                 | <i>Pinus</i> sp.                                  | Charcoal         | 0.03   | - | EC or earlier | 10036                    |
| CH5, U7, L7                                 | <i>Pinus</i> sp.                                  | Charcoal         | 0.18   | - | EC or earlier | 20018                    |
| E1, U9, L3                                  | <i>Pinus</i> sp.                                  | Charcoal         | 0.34   | - |               | 10037                    |

Areas farther from the central, western charred concentrations, CC 2 and CC 5, have much less maize and more remains of the unknown weedy shoots (Figure 5.45). A layer of the grass-like plant may have been laid down as a “carpet” upon which to place the offerings. The fact that CC 2 and CC 5 have more remains from the weedy genus than maize is probably because they are located along the periphery of Feature 23, farther from the central, western focus.

**Residue Analysis.** An amorphous residue sample collected from Ledge 2, Area D, Bone Cluster 25, was submitted for Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry analysis (Figure 5.46). FT-ICR MS revealed 276 measurable molecular peaks in the archaeological sample. As at Actun Chechem Ha, the tested archaeological sample shares more peaks with modern *Pinus caribaea* than with other comparative samples. Seventy-one peaks, or 25.7%, are shared by both



the archaeological sample and *P. caribaea*. Fifty-four, or 20.7%, and 53, or 19.6%, peaks are shared by the archaeological sample and modern *Bursera simaruba* and *Protium copal*, respectively. The archaeological sample has the least in common with the copal sample obtained from highland Guatemala. In sum, FT-ICR MS reveals that the archaeological sample has commonalities with all comparative material, but overlaps most with *P. caribaea* and the Burseaceae taxa.

#### Actun Nak Beh

Eighteen flotation samples from 18 archaeological deposits and 37 macrofossil samples from 23 deposits were collected from Actun Nak Beh (Appendix A). Thirty-one deposits are represented in the archaeobotanical assemblage, combining flotation and macrofossil samples. Analyzed archaeobotanical remains were organized by provenience and are presented in Table 5.13. Samples from disturbed deposits are not included

**Wood Charcoal.** Wood charcoal dominates the Actun Nak Beh archaeobotanical assemblage and includes both pine (*Pinus* sp.) and various hardwoods (Figures 5.47). Ubiquity analysis reveals that pine is the dominant wood charcoal from Actun Nak Beh because 100% of all sampled archaeological deposits yielded pine charcoal (Figure 5.48). A similar pattern emerges when one compares the weight of pine and hardwood charcoal from one-liter flotation samples (Figure 5.49). The soils encountered at Actun Nak Beh were predominately dense silts and clays that increased the difficulty of extracting botanical remains through flotation. In this situation, relying on weights to measure the relative importance of taxa likely deflates the contribution of hardwoods to the archaeobotanical assemblage. As a result, ubiquity provides a much better picture of the distribution of wood resources at Actun Nak Beh. Because the overall ubiquity of pine is 100%, the spatial (i.e., cave interior and cave exterior) distribution of pine deposition is 100% as well. The temporal use of Actun Nak Beh spans the period from at least the Early Classic period to the Late Classic period. The chronological distribution of pine is also 100%.

The ubiquity of hardwood charcoal is substantially less than pine (Figure 5.48). Only 43% of sampled deposits contained hardwood charcoal. Hardwood taxa identified beyond the family level include *Byrsonima* sp. (17%) (Figure 5.47e), *Cassia* sp. (9%), *Andira inermis* (9%) (Figure 5.47f), and *Rheedia* sp. (4%) (Figure 5.47d), *Persea* sp. (4%) (Figure 5.47c), and *Aspidosperma* sp. (4%) (Figure 5.47b). Tentative identifications of cf. *Hymenaea coubaril* (4%) and cf. *Alvaradoa amorphoides* (4%) were made as well. Unfortunately, poor preservation of hardwood specimens restricted the identification of individual genera. Although archaeobotanical analysis was able to identify the presence of particular genera, quantitative comparisons of the differences among genera are limited.

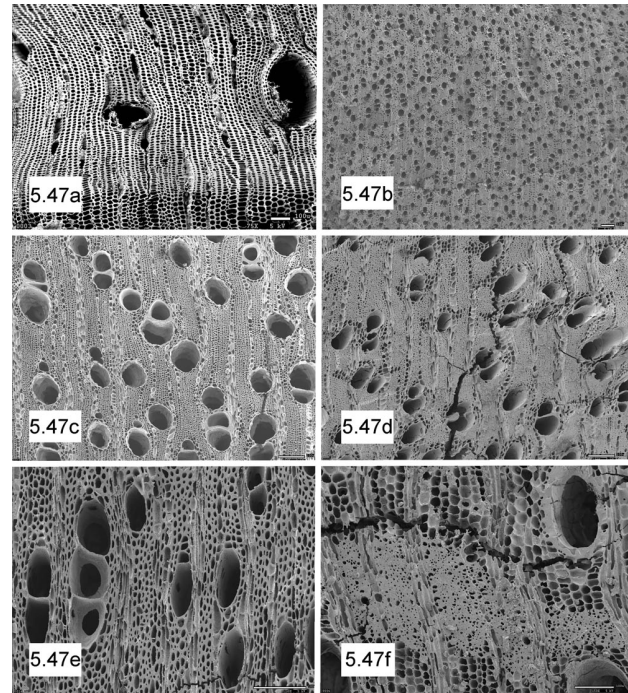


Figure 5.47: Wood charcoal from Actun Nak Beh. 5.47a: *Pinus* sp.X75 (20005-001). 5.47b: *Aspidosperma* sp. X50 (10021-006). 5.47c: *Persea* sp. X100 (10021-008). 5.47d: *Rheedia* sp. X100 (10013-003). 5.47e: *Byrsonima* sp. X200 (10014-003). 5.47f: *Andira inermis* X150 (10011-001).

The distribution of hardwood charcoal was quantified spatially and temporally. Figure 5.50 displays the ubiquity of hardwood charcoal recovered from the exterior and interior of Actun Nak Beh. Fifty-seven percent of the sampled deposits (n= 14) from the exterior of the cave contained hardwood charcoal, whereas 22% of the archaeological contexts (n= 9) from the cave's interior yielded hardwood charcoal. The higher hardwood ubiquity from the cave's exterior may reflect secondary processes, such as prehistoric burning outside the cave.

The spatial variation in the charcoal assemblage is influenced by chronological factors. Based on ceramic data, Actun Nak Beh' exterior was predominantly utilized during the Late Classic period, while the interior was used during the Early Classic or earlier. Figure 5.51 illustrates the temporal distribution of hardwoods at Actun Nak Beh. Some deposits were devoid of chronologically diagnostic ceramics, but those contexts are at least as old as the overlying deposits. One sample from the cave's exterior (ID 20013) is below Late Classic period (Spanish Lookout Phase) deposits. The sample's actual temporal placement may be earlier, however, possibly extending into the Early Classic period. The only sample from Unit 9 is of unknown date. Thus, these samples are excluded from Figure 5.51. All samples that contain hardwood charcoal from the cave's interior are from deposits without diagnostic ceramics. They are all from contexts beneath Early Classic deposits. Consequently, there is little possibility that they are from the Late Classic period.

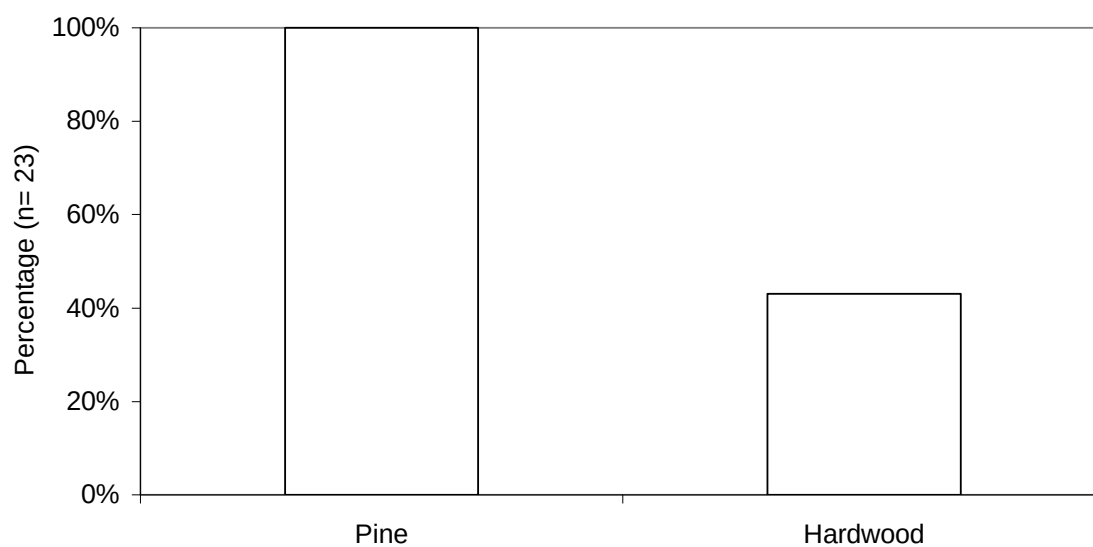


Figure 5.48: Difference between pine and hardwood charcoal at Actun Nak Beh measured by ubiquity.

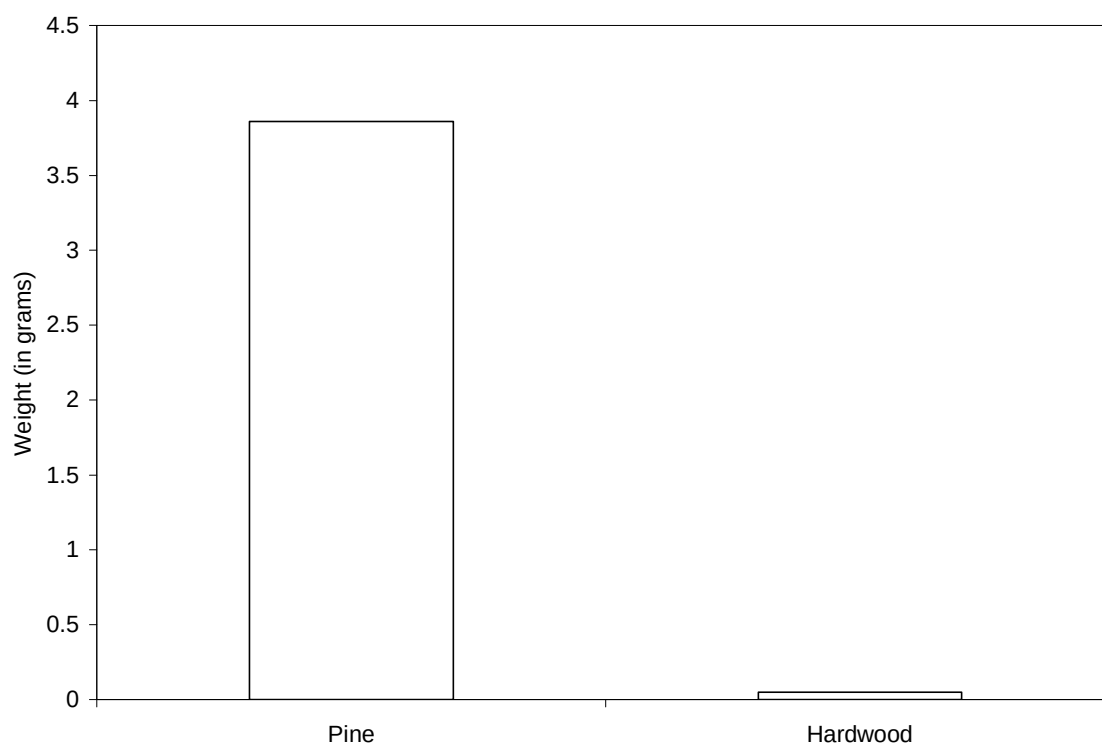


Figure 5.49: Difference between pine and hardwood charcoal measured by weight from flotation samples

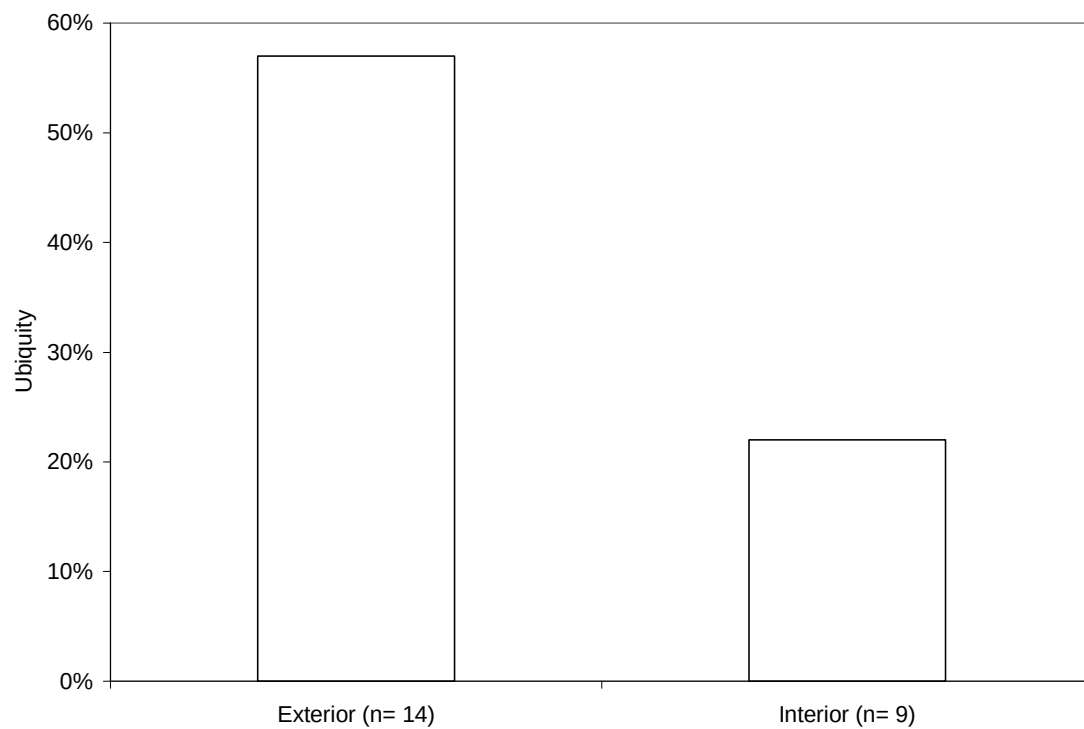


Figure 5.50: Spatial distribution of hardwood charcoal at Actun Nak Beh.

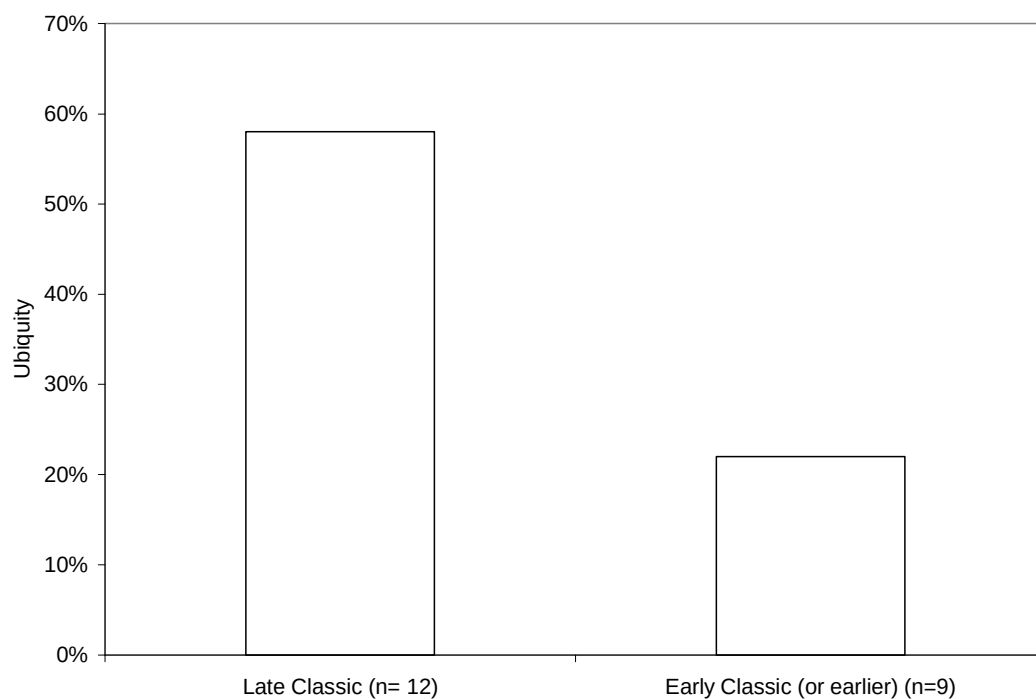


Figure 5.51: Temporal distribution of hardwood charcoal at Actun Nak Beh.

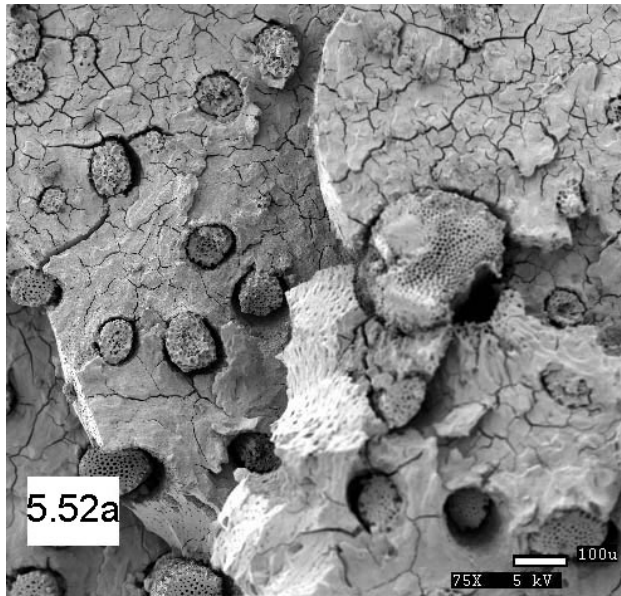


Figure 5.52: Tree fruit remains from Actun Nak Beh. 5.52a: SEM of *Attalea cohune* endocarp X75 (10011-002). 5.52b: *Byrsonima crassifolia* pit (Marks indicate 1mm) (10021-002).

These data are nevertheless useful in demonstrating temporal trends in the charcoal assemblage and are included in Figure 5.51. One should be aware that they might predate the Early Classic period. The relationship between the chronological and spatial distribution of hardwood charcoal at Actun Nak Beh is clear when comparing Figure 5.50 with Figure 5.51. Fifty-eight percent of Late Classic deposits ( $n=12$ ) contain hardwood charcoal, whereas 22 % of Early Classic deposits ( $n=9$ ) contain hardwoods. The variation between chronology and space is virtually identical.

All wood specimens from Actun Nak Beh appear to be from mature wood. Poor degree of preservation influences this conclusion by limiting determinations of maturity in some specimens, however.

**Fruit Remains.** The remains of fruits from economically useful trees are represented in the archaeobotanical assemblage from Actun Nak Beh (Table 13). Carbonized remains of tree fruits were recovered exclusively from the exterior of Actun Nak Beh. Sampled deposits containing palm macrofossils were found from contexts dated to the Late Classic period (Spanish Lookout Phase). A total of five stratigraphically secure deposits yielded palm remains. The palms from three sampled contexts have been identified as cohune (*Attalea cohune*) (Figure 5.52a). One palm sample was associated with the burial of a single individual (Burial 2). It is possible that some of the remains reflect natural processes because animals that inhabit the cave and the surrounding region eat the fruits of various species of palms. The recovery of palm macrofloral material from a number of secure deposits, including cohune endocarps directly associated with a burial, strengthens the likelihood that their deposition was the result of ancient human activity, however.

In addition to palms, the pits of nance fruits (*Byrsonima crassifolia*) (Figure 5.52b) and a possible Rosaceae pit were also recovered (Table 5.13). These remains were recovered from two Late Classic period deposits, both associated with Burial 2. As with palms, there is a possibility that these specimens entered the archaeological record through natural means. The likelihood that they are the remnants of cultural activities is strong. The macrofossils came from one spatially and temporally discrete locus that is stratigraphically secure, and the remains of these taxa were not found elsewhere at Actun Nak Beh, including disturbed contexts.

The data on trees that yield edible fruits can be increased if one includes the wood charcoal from archaeologically attested, fruit-bearing hardwoods, particularly nance wood and avocado wood (*Persea* sp.). Nance charcoal was recovered from four Late Classic period deposits, including samples associated with Burial 2 (Table 5.13). Avocado charcoal was retrieved solely from Burial 2. The charcoal remains of the two taxa can only be considered indirect, tentative evidence for the use of their fruits in these deposits, especially since the part of the plant represented, carbonized wood, indicates another function (i.e., fuel). When evaluating other deposits containing nance charcoal, the fact that nance charcoal was found in the same deposit containing nance fruits (Burial 2) strengthens the possibility that the taxon's primary function involved the utilization of its fruits.

No avocado fruits were recovered from Actun Nak Beh, and conclusions about fruit use based solely on avocado charcoal are weak. Nevertheless, the presence of avocado wood, taken together with the evidence for other fruit trees, reinforces the focus on tree fruits at Actun Nak Beh as well as the significance of fruit trees in Late Classic period food assemblages generally.

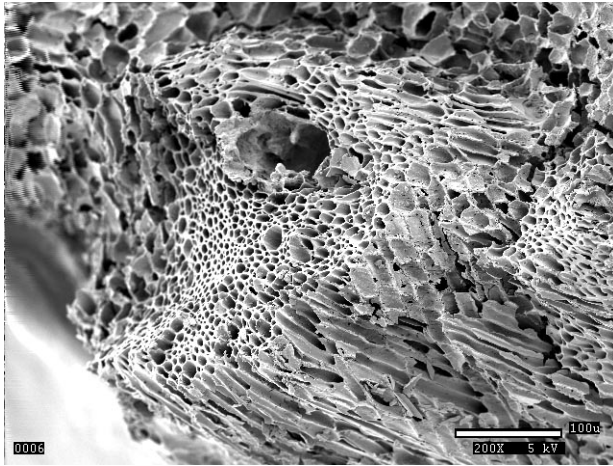


Figure 5.53: SEM of carbonized parenchymatous tissue, possibly from the family Euphorbiaceae X200 (10021-001).

**Domesticated Plants.** No archaeobotanical specimens from clearly domesticated cultigens were retrieved from Actun Nak Beh. One potential exception is a small, fragmentary specimen of carbonized parenchymatous tissue (Table 5.13: E1, U1-ext, L8, Burial 2) (Figure 5.53). This specimen has been identified as the possible remains of a root organ from the Euphorbiaceae family. This taxonomic determination was made based on similarities with manioc (*Manihot esculenta*), a starchy root crop that was cultivated by ancient Mesoamerican agriculturalists (see Chapter 2). The specimen lacks any discernible vascular tissue, an attribute that is needed to obtain a more secure identification. As a result, the present identification is tentative. Other food items were recovered from the same deposit (i.e., nance, cohune, and possibly avocado), however, and the presence of manioc is a possibility.

**Other Macrofloral Remains.** Other plant remains were recovered from Actun Nak Beh (Table 5.13). One Early Classic period deposit yielded two small seeds (CH5, U7, L2). One unidentified specimen was not carbonized and may be intrusive. The other specimen is a charred grass caryopsis from the Poaceae family. Due to the specimen's small size and given the fact that no other grass remains were recovered from the entire excavation unit, the archaeological significance of the find is uncertain. Although it is plausible that the caryopsis is the remnant of an ancient activity, the possibilities that it was either unintentionally deposited during prehistory or is intrusive from other levels cannot be ruled out.

Two carbonized achenes from the Compositae family were recovered from a Late Classic period deposit (E1, U1-ext, L8). These remains are associated with Burial 2. The Compositae family is composed of mostly herbaceous dicots that are often pioneer species in the early succession of forest regeneration. Because the achenes were found in the exterior portion of Actun Nak Beh, it is possible that they reflect secondary processes such as burning outside the cave. It is also possible that

the achenes are the remains of plant material that was purposefully deposited by the Late Classic groups who used Actun Nak Beh. If weedy, herbaceous flora were selected for ceremonial utilization, the recovery of Compositae achenes may increase the archaeological significance of the grass caryopsis just discussed.

Finally, small fragments of charred dicot rinds were retrieved from one context (CH5, U7, L5). The deposit that yielded the rinds was beneath stratigraphic levels dated to the Early Classic period (Hermitage Phase). Thus, the context dates at least to the Early Classic period, though it is possibly older. Like the caryopsis and achenes described above, the archaeological significance of the isolated rinds is uncertain. Anatomically, the fragments do not appear to be taxonomically related to other rind-producing dicots, such as calabash (*Crescentia cujete*) and cacao (*Theobroma cacao*). The dissimilarity may be the result of the specimens' fragmentary condition.

**Residue Analysis.** Thirty percent of undisturbed archaeological deposits yielded charred residue (Table 5.13). These deposits date from both the Late Classic and the Early Classic periods. A sample of the residue from Burial 2 was submitted for Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (Figure 5.54). As at the other cave sites, the archaeological sample shares most molecular peaks, 13.2%, with *Pinus caribaea*. The archaeological sample has 8.8% and 7.6% of its peaks in common with *Protium copal* and *Bursera simaruba*, respectively. The fewest number of peaks are shared by the archaeological sample and the copal sample. The low level of similarity to comparative material may be due to the fact that preservation was poorer at Actun Nak Beh, a factor that increased weathering of the archaeological sample's constituent chemical compounds.

#### Twin Caves 2

Brief reconnaissance was undertaken at Twin Caves 2. Researchers discovered a hearth feature on the surface of the westernmost end of the cave's interior. Two one-liter flotation samples were collected from the feature (Appendix A). The ceramics associated with the hearth are exclusively from the early Late Classic period (Tiger Run Phase, ca. A.D. 600-700) (Christophe Helmke, personal communication 2001), indicating a short period of utilization. The feature's condition was excellent; it was undisturbed by looters and animals. The results of archaeobotanical analysis are presented in Table 5.14.

**Wood Charcoal.** Ubiquity analysis of the distribution of wood charcoal cannot be applied to the archaeobotanical assemblage from Twin Caves 2 because the data are from only one context. The preservation of botanical material was good. Thus, variations in the weight of taxa should provide an accurate assessment of their relative importance. Analyses of charcoal based on weight are presented in Figure 5.55.

## Actun Nak Beh Ha vs. Comparative Sample

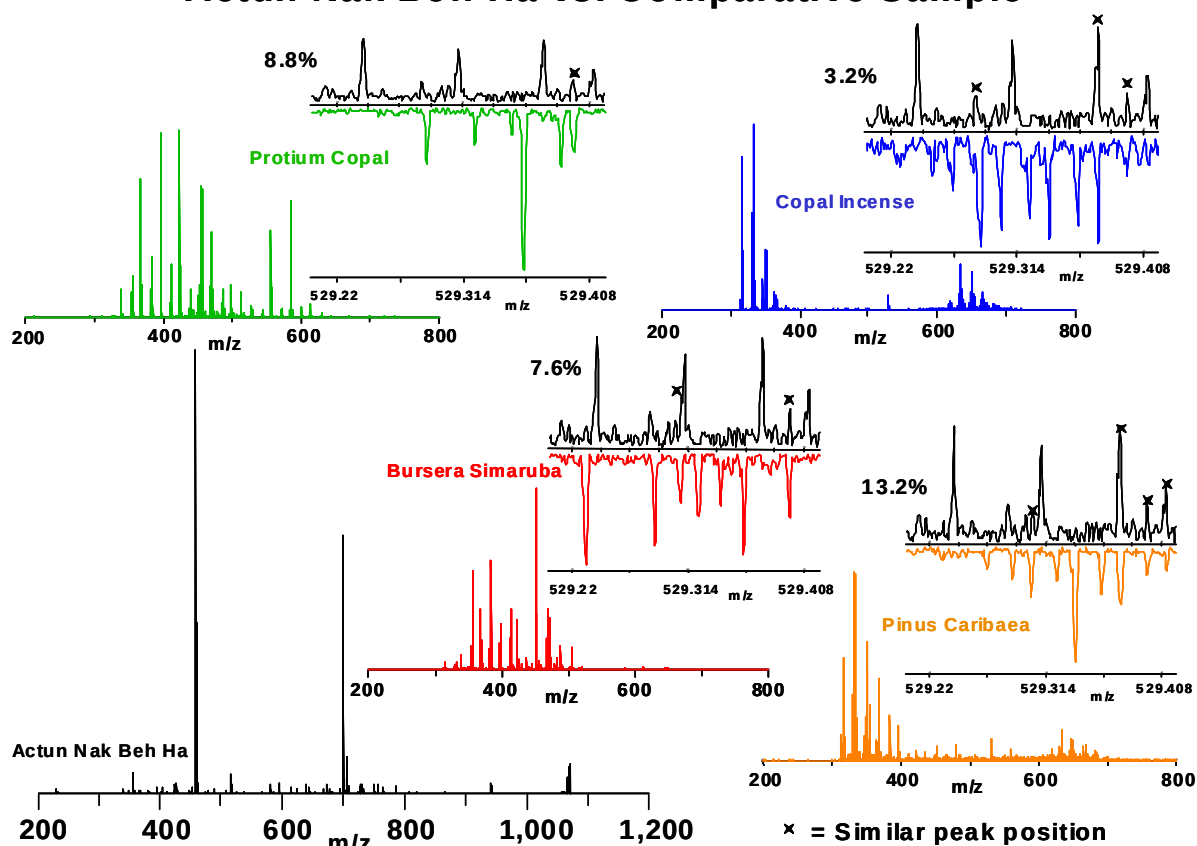


Figure 5.54: Results of Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) conducted on a carbonized residue sample from Burial 2 (10021-003).

Table 5.14: Archaeobotanical remains recovered from Twin Caves 2, Cayo District, Belize.

| Provenience        | Scientific Name              | Part      | Weight | #  | ID Number    |
|--------------------|------------------------------|-----------|--------|----|--------------|
| West End<br>Alcove | <i>Pinus</i> sp.             | Charcoal  | 2.6    | -  | 20023, 20024 |
|                    | <i>Tabernaemontana</i> sp.   | Charcoal  | > 0.01 | -  |              |
|                    | Hardwood                     | Charcoal  | 0.05   | -  |              |
|                    | Dicot                        | Charcoal  | 0.03   | -  |              |
|                    | <i>Spondias</i> sp.          | Fruit pit | 1.3    | >1 |              |
|                    | <i>Byrsonima crassifolia</i> | Seed      | 0.05   | 1  |              |
|                    | <i>Passiflora</i> sp.        | Seed      | > 0.01 | 1  |              |
|                    | <i>Protium</i> sp.           | Seed      | 0.01   | 1  |              |

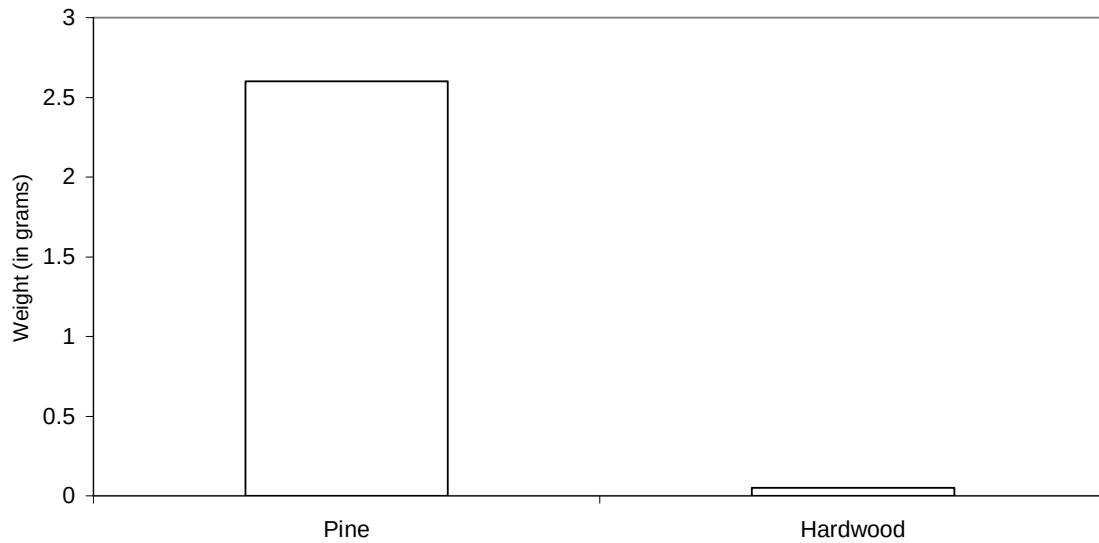


Figure 5.55: Difference between pine and hardwood charcoal from Twin Caves 2 measured by weight.

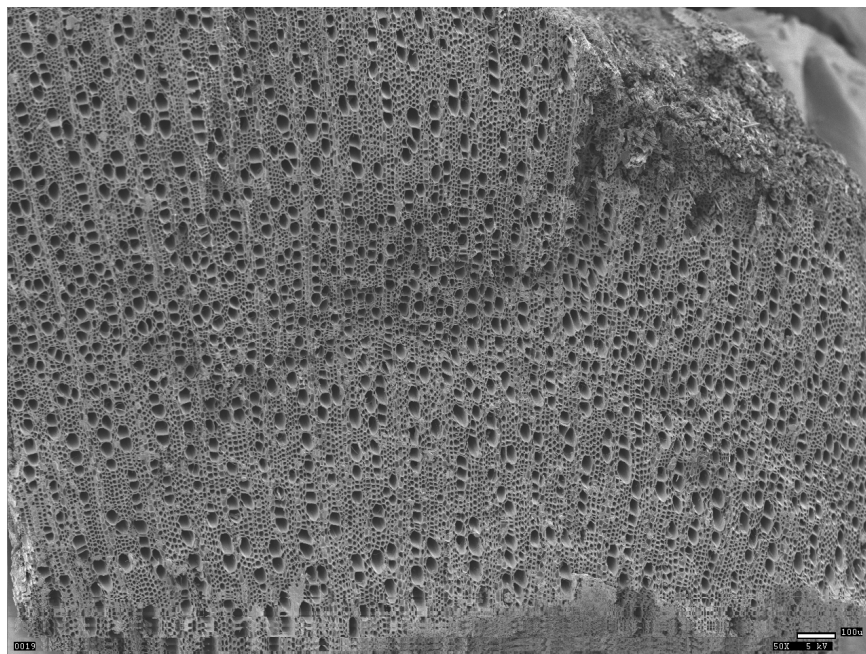


Figure 5.56: *Tabernaemontana* sp. charcoal X50 (20024-002).

Pine charcoal was the dominant wood charcoal from Twin Caves 2 (Figure 5.55). 2.6 g of pine were retrieved from the hearth feature. Only 0.05 g of hardwood charcoal were recovered. Less than one gram of hardwood charcoal was identified as *Tabernaemontana* sp. (Figure 5.56), and it is from a young stem or branch. The remaining 0.05 g of hardwood charcoal could not be identified to family, genus, or species. Finally, 0.03 g of charcoal were only identified as dicots.

**Fruit Remains.** The hearth feature at Twin Caves 2 also yielded a number of seeds and pits from economically useful species (Table 5.14). 1.3 grams of carbonized hog

plum (*Spondias* sp.) pits were recovered (Figure 5.57c). The majority of the hog plum pits were in fragments.

Thus, it was impossible to discern the number of individuals pit specimens represented. Other carbonized fruit remains include a single nance pit, one passion fruit seed (*Passiflora* sp.) (Figure 5.57a), and a copal seed (*Protium* sp.) (Figure 5.57b). Although the hearth was in good condition prior to sampling, the fact that it is a surface deposit increases the chance that the fruit remains were naturally deposited. The seeds and pit fragments are, nevertheless, carbonized. It is likely that their burning was coeval with the burning of the wood taxa.



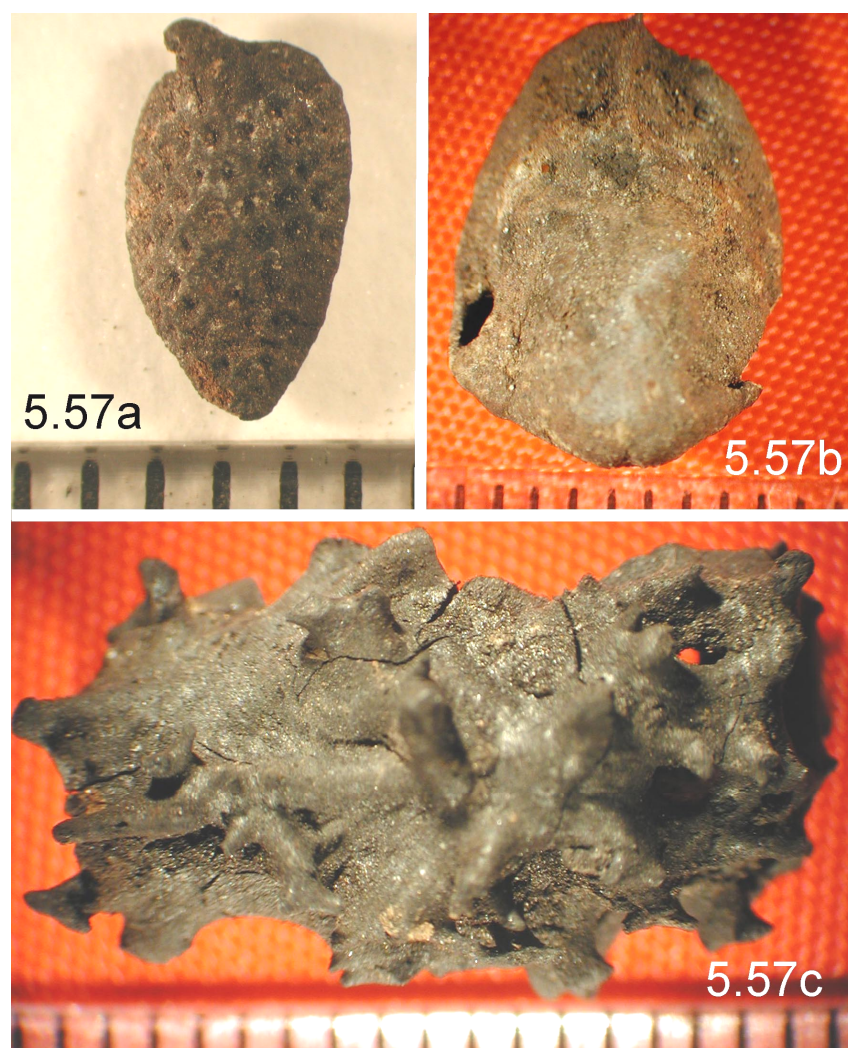


Figure 5.57: Seeds and pit remains from Twin Caves 2 (Marks indicate 1mm). 5.57a: *Passiflora* sp. (20023-006). 5.57b: *Protium* sp. (20024-006). 5.57c: *Spondias* sp. (20024-005).

Table 5.15: Archaeobotanical remains from Laberinto de las Tarantulas (Tarantula Cave), Cayo District, Belize.

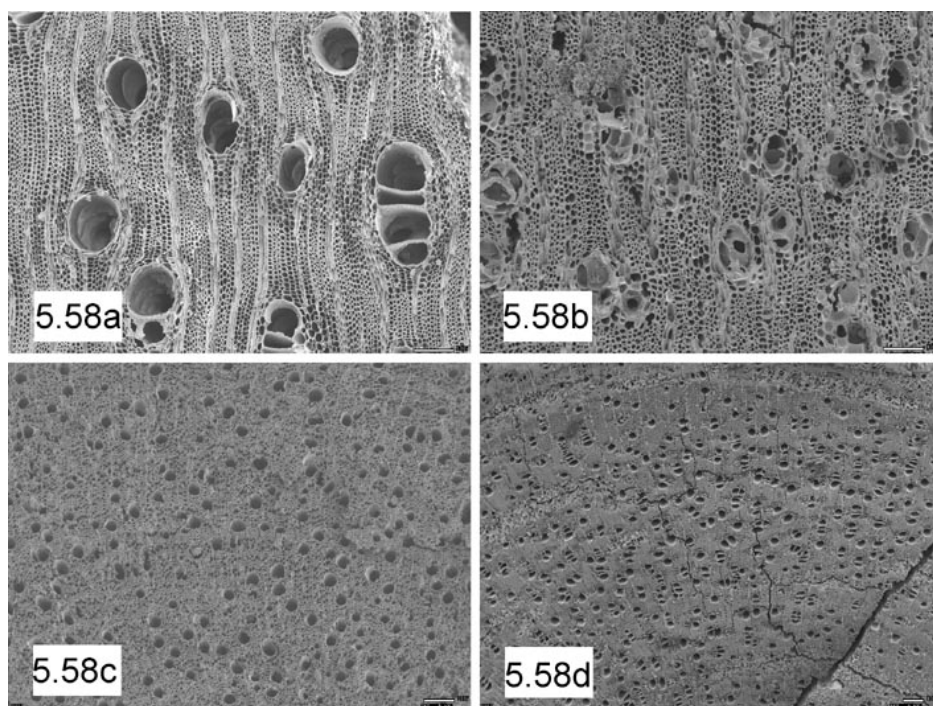
| Provenience              | Scientific Name         | Part               | Weight | # | ID Number   |
|--------------------------|-------------------------|--------------------|--------|---|-------------|
| Passage 9,<br>Cluster 67 | <i>Pinus</i> sp.        | Charcoal           | 1.86   | - | 20019-20022 |
|                          | <i>Enterolobium</i> sp. | Charcoal           | 0.11   | - |             |
|                          | <i>Aspidosperma</i> sp. | Charcoal           | 0.08   | - |             |
|                          | <i>Cordia</i> sp.       | Charcoal           | 2.08   | - |             |
|                          | Bignoniaceae            | Charcoal           | 0.17   | - |             |
|                          | Sapotaceae              | Charcoal           | 0.95   | - |             |
|                          | Lauraceae               | Charcoal           | 0.08   | - |             |
|                          | Hardwood                | Charcoal           | 0.34   | - |             |
|                          | Dicot                   | Charcoal           | 0.1    | - |             |
|                          | Unknown                 | Carbonized Residue | 0.04   | - |             |

The possibility remains, however, that the fruits were naturally deposited before the hearth's utilization, and, consequently, were burned with the wood. Due to the uncertainty surrounding the fruit macrofossils, they should be evaluated cautiously.

#### *Laberinto de las Tarantulas (Tarantula Cave)*

Investigators went to Tarantula Cave over several seasons to map the cave and record archaeological data. An inner passage (Passage 9) containing human remains was





Figures 5.58: Wood charcoal from Tarantula Cave. 5.58a: *Enterolobium* sp. X100 (20022-004). 5.58b: *Cordia* sp. X100 (20022-006). 5.58c: *Aspidosperma* sp. X75 (20022-005). 5.58d: Bignoniaceae X50 (20021-003).

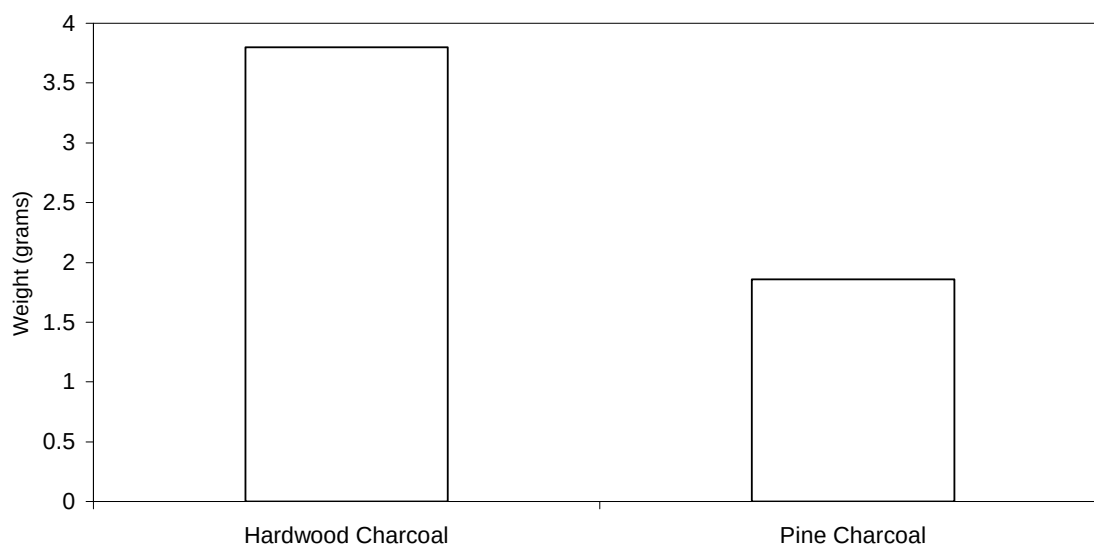


Figure 5.59: Difference between pine and hardwood charcoal from Tarantula Cave measured by weight.

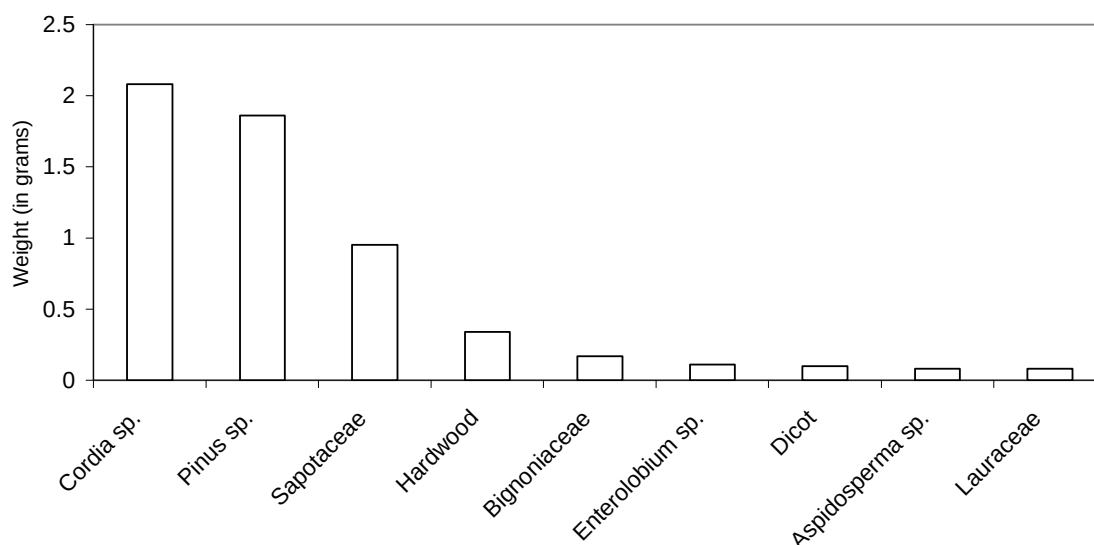


Figure 5.60: Comparison of charcoal taxa from Tarantula Cave based on weight.

encountered. Five, one-liter flotation samples were recovered from a concentration of human remains and artifacts (Cluster 67). Each was collected up to a depth of 15 m (Cameron Griffith 2000, personal communications). After flotation, four samples were analyzed for botanical remains. One was saved for future radiocarbon analysis. Archaeobotanical results are presented in Table 5.15.

The chronological depth of Tarantula Cave is not extensive. Ceramics recovered from Tarantula Cave are predominantly from the Terminal Classic period (late facet of the Spanish Lookout Phase) (Helmke et al. 1999; Ishihara and Helmke 2002). Tarantula Cave seems to have experienced a short period of utilization during the Terminal Classic period (Ishihara and Helmke 2002).

**Wood Charcoal.** With the exception of 0.04 g of an unknown, carbonized residue, wood charcoal is the only type of archaeobotanical remains recovered from Tarantula Cave (Figures 5.58). As at Twin Caves 2, quantification of the charcoal cannot rely on ubiquity because only one context was sampled. Figures 5.59 and 5.60 present the comparisons of wood charcoal based on weights.

Unlike the other cave sites in the Roaring Creek River Valley, pine is not the dominant wood charcoal recovered from Tarantula Cave (Figure 5.59). A total of 3.8 g of hardwood charcoal was retrieved compared to only 1.86 g of pine. If one examines the relative importance of individual taxa, however, pine is second in abundance (Figure 5.60). *Cordia* sp. is the dominant genus by weight (Figure 5.58b), represented by 2.08 g of charcoal. Other hardwood taxa from Tarantula Cave include charcoal from the families Sapotaceae (0.95 g), Bignoniaceae (0.17 g) (Figure 5.58d), and Lauraceae (0.04 g). More specific identifications were possible for two other genera

of hardwoods as well, including *Enterolobium* sp. (0.11 g) (Figure 5.58a) and *Aspidosperma* sp. (0.08 g) (Figure 5.58c). It should be noted that all *Aspidosperma* and Bignoniaceae charcoal specimens are from underdeveloped wood. There are many genera of woody vines in the family Bignoniaceae (Balick et al. 2000:138-140). Thus, the Bignoniaceae remains represented in the charcoal assemblage may be from burned vines rather than from young tree stems or branches.

## Intersite Comparison of Archaeobotanical Remains

### Wood Charcoal

Carbonized wood was the dominant type of macroflora recovered from all caves. Pine and numerous taxa of hardwoods were found in abundance. Intersite comparability of charcoal assemblages is hindered to some extent by differences in preservation and sampling methodologies at each cave site, limiting the quantification of data. Some patterns in the charcoal assemblages can be observed and evaluated collectively, however.

Figures 5.61 and 5.62 display the differences in hardwood and pine charcoal at the cave sites based on ubiquity values and weight values from flotation samples, respectively. Twin Caves 2 and Tarantula Cave are excluded from the ubiquity comparison because only one context was sampled from each site. Actun Chechem Ha is excluded from the weight comparison because only one flotation sample was collected. Weight values of pine and hardwood charcoal at each cave have been standardized (i.e., pine or hardwood charcoal weight from site A / total charcoal weight from site A) in order to establish comparability between assemblages.

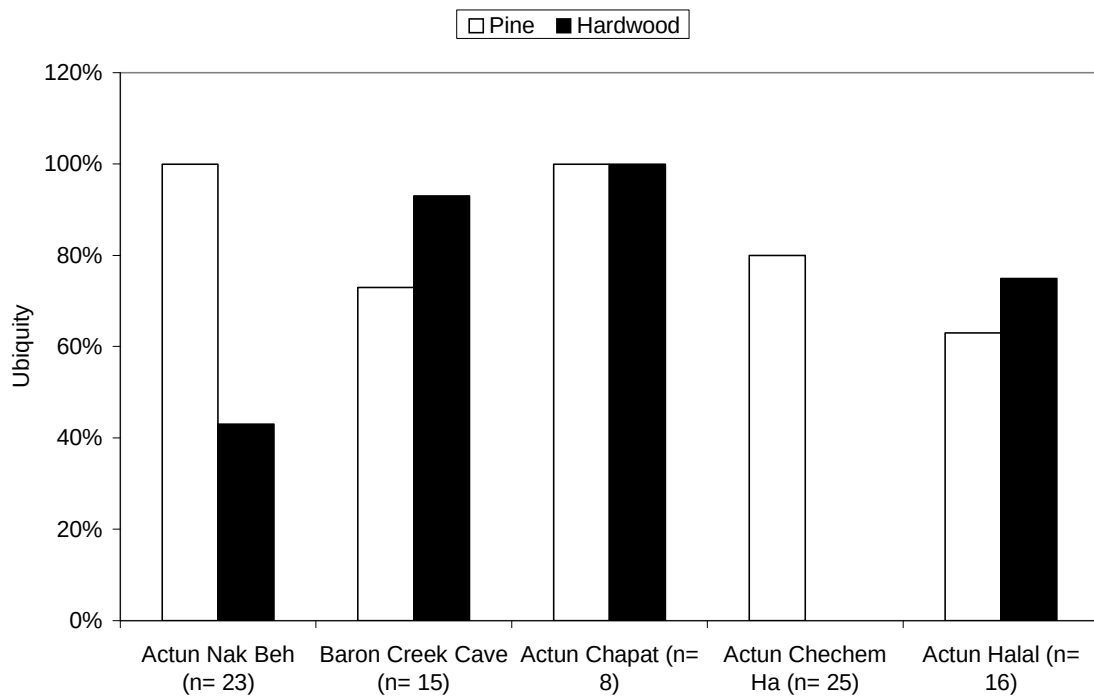


Figure 5.61: Differences between pine and hardwood charcoal at cave sites measured by ubiquity.

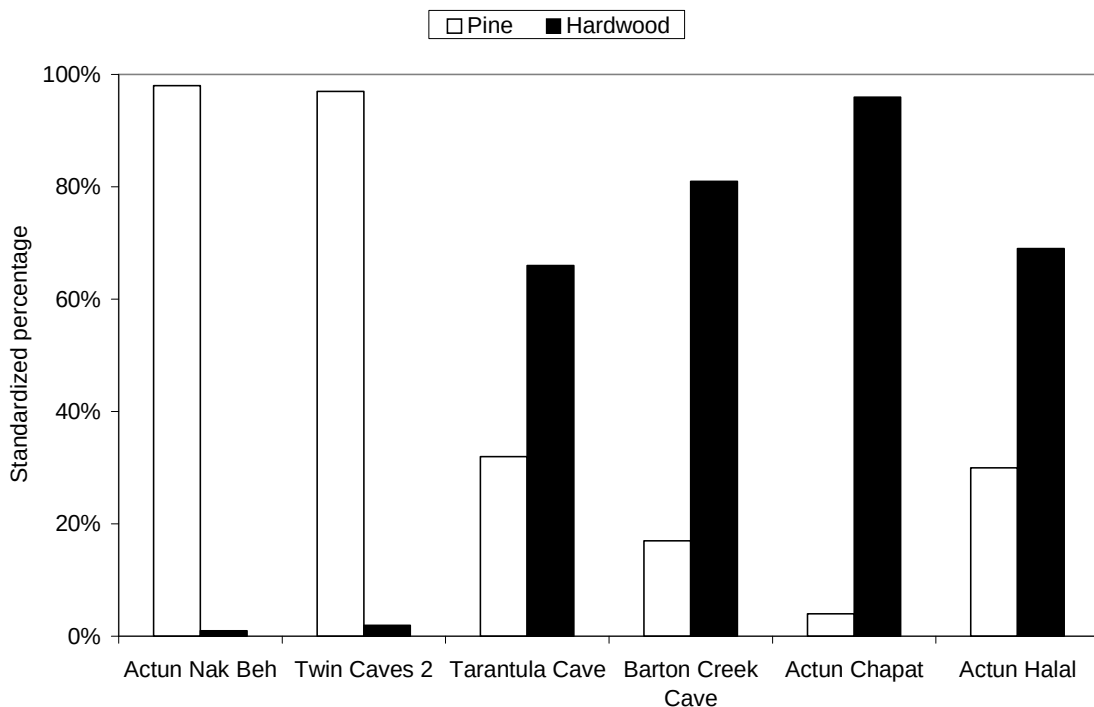


Figure 5.62: Differences between pine and hardwood charcoal at cave sites measured by standardized weight values.

As discussed in the preceding section, the ubiquity of both pine and hardwood charcoal varies among the caves (Figure 5.61). Actun Chechem Ha yielded only pine and no hardwood charcoal. Actun Nak Beh has a preponderance of pine charcoal. All sampled archaeological deposits yielded pine charcoal (100%) whereas less than half (43%) yielded hardwood charcoal. At Actun Chapat, the ubiquity for pine and hardwoods is

the same (100%). The remaining cave sites, Actun Halal and Barton Creek Cave, contained a higher number of deposits yielding hardwoods than pine. The disturbed contexts at Actun Halal may have biased the representation of hardwood and pine charcoal contained in the archaeobotanical assemblage. Pine charcoal was still recovered from over half of the sampled deposits at all cave sites, however.

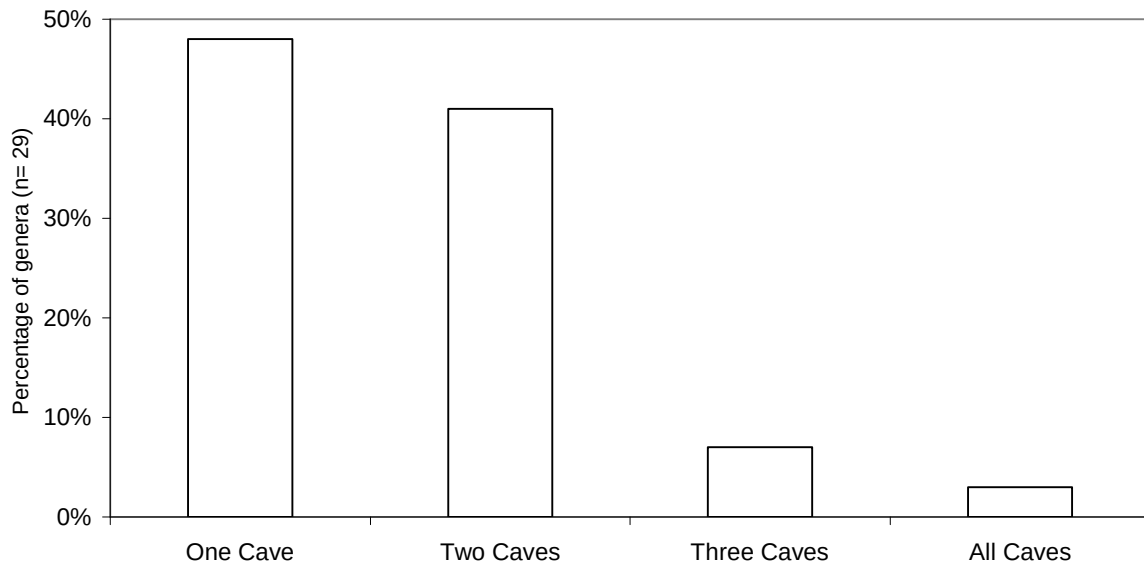


Figure 5.63: Percentage of charcoal genera recovered from one, two, three, and all cave sites.

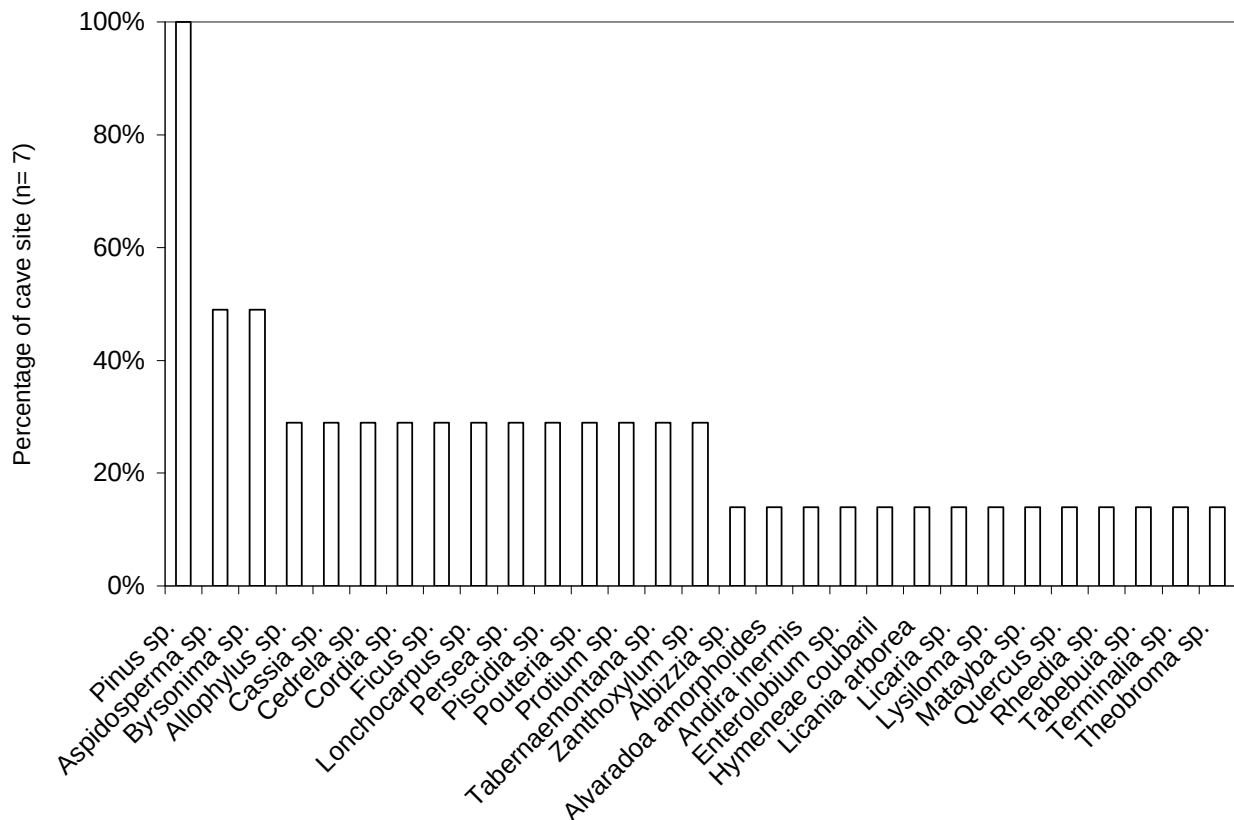


Figure 5.64: Intersite distribution of charcoal genera from the seven cave sites.

A comparison of the standardized weights of pine and hardwood charcoal among the caves demonstrates that cave sites in the Roaring Creek Valley have more pine than caves in the Macal River Valley and the Barton Creek Valley (Figure 5.62). Actun Nak Beh and Twin Caves 2 yielded proportionately more pine than hardwood charcoal compared to the other cave sites. The similarity in the distributions of pine and hardwood charcoal is close at both sites. Pine comprises 98% of Actun Nak Beh's

charcoal assemblage whereas hardwoods comprise only 1%. At Twin Caves 2, pine makes up 97% of the site's charcoal assemblage whereas hardwoods make up only 2%. Tarantula Cave's assemblage contained proportionately more hardwood charcoal than pine charcoal (66% versus 32%). Nevertheless, Tarantula Cave still yielded more pine charcoal than Barton Creek Cave, Actun Chapat, and Actun Halal. The standardized weights of both charcoal groups at Actun Halal are similar to

Tarantula Cave's charcoal collection, where 69% of the charcoal is from hardwoods and 30% is from pine. The archaeobotanical assemblage from Actun Halal may be biased, however. If Actun Halal is excluded from consideration, a reduction in the proportion of pine charcoal can be seen as the geographic distance from the Roaring Creek Valley increases.

The overall distribution of individual genera of wood charcoal can be examined regionally (Figures 5.63-5.64). Ubiquity values are based on the presence or absence of a genus at a particular site, rather than taking into account the intrasite ubiquity scores. Intersite comparison of wood genera reveals that most taxa were recovered from only one (48%) or two (41%) sites (Figure 5.63). Substantially fewer genera were recovered from three sites (7%), and even fewer were represented in the charcoal assemblage from all sites (3%). No genera were recovered from four, five, or six sites. Figure 5.64 displays the distribution of individual genera of wood charcoal based on whether they were recovered from one (14%), two (29%), three (49%), or all (100%) cave sites.

The data reveal the significance of pine at the intersite level. Pine is the only genus that was recovered from all cave sites (Figure 5.64). Pine is the most ubiquitous genus within the individual caves as well. Hardwood genera showed variability in their occurrence at individual cave sites. *Piscidia* sp. and *Protium* sp. were both recovered from only two cave sites (29%), Actun Chapat and Barton Creek Cave, and both genera comprise a substantial portion of both sites' assemblages. Although *Byrsonima* sp. was recovered from 49% of the cave sites, its abundance is variable at each cave. At Actun Nak Beh, *Byrsonima* is the most ubiquitous hardwood charcoal. At Actun Chapat, *Byrsonima* is the fourth most common hardwood, and, at Barton Creek Cave, it is the second most common.

#### Botanical Foodstuffs

Archaeobotanical remains from foodstuffs are abundant in the caves' floral assemblages, including plant material from domesticated crops and charred fragments of edible fruits. The remains of edible fruits include endocarps and complete pits as well as seeds. Actun Nak Beh is the only cave where carbonized fruit remains can be securely attributable to ancient cultural activities. At Actun Nak Beh, endocarps from the cohune palm (*Attalea cohune*) and pits from nance (*Byrsonima crassifolia*) were recovered from a burial (Burial 2) located in the cave's entrance (Table 5.13).

Other cave sites yielded fruit remains, but their presence in the archaeological record may reflect natural processes. At Twin Caves 2, a passion fruit seed (*Passiflora* sp.) and hog plum (*Spondias* sp.) pit fragments were found. A copal (*Protium* sp.) seed was also recovered, although copal fruits are not known for their edibility. The hearth feature from Twin Caves 2 is located on the surface of the cave floor. It is possible that the seeds were culturally

deposited and ceremonially burned with the wood, but it is equally plausible that the fruits were naturally deposited prior to burning and, as a result, were burned with the wood.

Two carbonized grape (*Vitis tiliifolia*) seeds were recovered from two contexts at Barton Creek Cave (Table 5.9). The possibility that bats deposited these seeds cannot be ruled out. Archaeological deposits at Barton Creek Cave are shallow, and most concentrations of archaeological remains are unsealed, surface deposits. Thus, there is a higher chance of mixing of naturally and culturally occurring flora. Feature 23, one of the contexts that yielded a grape seed, was sealed by rock that spalled off the cave wall and ceiling, a factor that also contributed to the remarkable preservation of organic materials encountered. Nevertheless, as at Twin Caves 2, bats may have left the grape seed prior to the deposition and burning of the wood charcoal and domesticates.

Macrofloral remains from domesticated plants were recovered from Actun Chechem Ha and Actun Chapat in Macal River Valley and from Barton Creek Cave in Barton Creek Valley. No remains from clearly domesticated plants were found at caves in Roaring Creek Valley. One possible exception is the charred fragment of parenchymatous tissue recovered from Actun Nak Beh (see above) that may be the remnants of a root crop, though the identification is tentative.

Archaeobotanical remains of domesticated cultigens include common beans (*Phaseolus vulgaris*), two species of squash (*Cucurbita moschata* and *Cucurbita pepo*), chile peppers (*Capsicum annum*), and maize (*Zea mays*). Maize remains are the most common domesticated crop at both the intrasite and intersite levels. Maize specimens include kernels, complete and fragmented cobs, and, at Barton Creek Cave, stems and intact ears. Also, maize starch grains were found in vessels at Actun Chechem Ha.

The combined maize remains from all cave sites were subjected to bi-variate analyses in order to reveal possible intersite variation in the maize assemblage. Analysis focuses solely on cupules, the most common part of the maize cob represented at each site, because there are substantial differences in the preservation of the maize at each site. The average of cupule measurements from each maize-yielding deposit is used (i.e., Actun Chapat, Unit 10, Level 3; Actun Chapat, Unit 10, Level 4; Actun Chechem Ha, Ledge 6, Olla 3; Actun Chechem Ha, Elevated Passage 3; Barton Creek Cave, Feature 23; Barton Creek Cave, Bone Cluster 1). Results of bi-variate analyses are displayed in Figures 5.65 and 5.66.

The most notable feature revealed in the comparison of cupule width to cupule wing width and cupule width to cupule length is that maize remains from each cave site generally cluster into distinct groups. The maize from Actun Chapat, Unit 10, Level 3, is the only exception to this pattern. In both Figure 5.65 and Figure 5.66, the maize from Chapat's Unit 10, Level 3, does not group

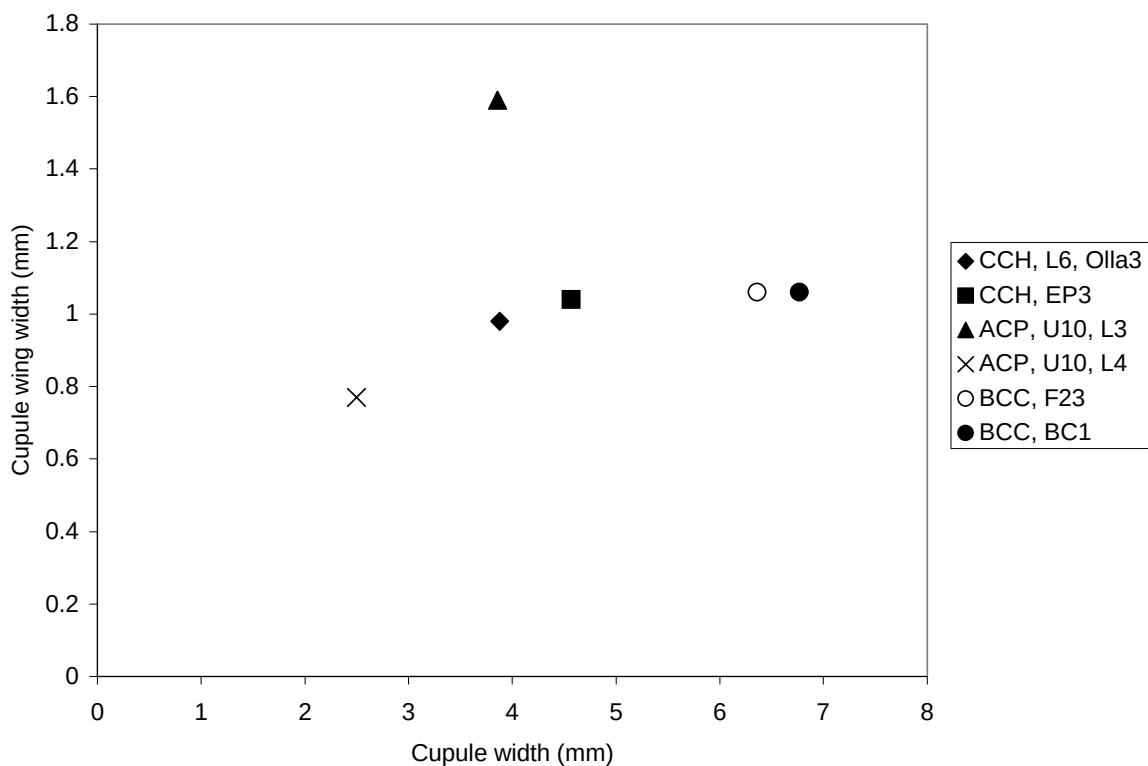


Figure 5.65: Comparison of cupule width and cupule wing width among maize remains from Actun Chechem Ha (CCH), Actun Chapat (ACP), and Barton Creek Cave (BCC).

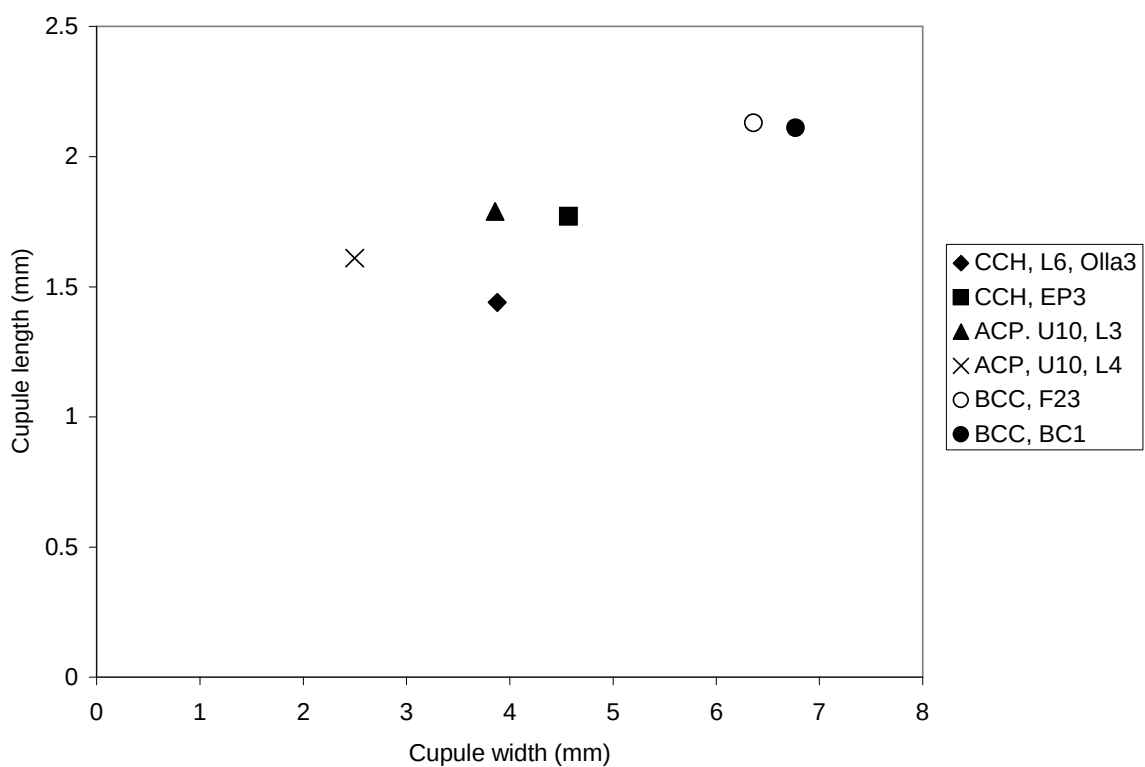


Figure 5.66: Comparison of cupule width and cupule length among maize remains from Actun Chechem Ha (CCH), Actun Chapat (ACP), and Barton Creek Cave (BCC).

with the maize from Level 4 of the same unit. In terms of cupule width and cupule length, Chapat's Level 3 maize is more similar to maize from Actun Chechem Ha (Figure 5.66). On the other hand, Level 3's prominently flared cupule wings differ significantly from Actun Chechem Ha's maize (Figure 5.65). Because the maize from Actun Chechem Ha lacks the flared cupule wings found in specimens from Actun Chapat, Unit 10, Level 3, this attribute can be considered a key feature for distinguishing Actun Chapat's Unit 10, Level 3, maize from maize from Actun Chechem Ha. As discussed previously, the cobs from Actun Chechem Ha appear to be from underdeveloped ears of maize. This fact explains why the Late Classic period maize from Actun Chechem Ha is similar to the small, Early Classic period maize from Actun Chapat in terms of cupule width and cupule length.

According to the present data, cupule width increases significantly through time. The specimens from Actun Chapat, Unit 10, Level 4, which may predate the Early Classic period, have the narrowest cupules, and the Late Classic period maize from Barton Creek Cave have the widest. Although the maize from Actun Chechem Ha falls in between these groups, the immaturity of Chechem Ha's cobs most likely skews their results. The increased cupule width in maize specimens from Actun Chapat, Unit 10, Level 3 compared to Unit 10, Level 4, would be expected if Level 4 is associated with an earlier time period.

### Residues

Analyses of carbonized residues from the cave sites indicate substantial similarities with pine and trees from the Burseraceae family. Samples of carbonized residues were collected from the cave sites. One sample each from Barton Creek Cave, Actun Chechem Ha, and Actun Nak Beh was subjected to Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) for molecular comparisons with modern reference material for identification. Archaeological specimens were compared to comparative botanical specimens, namely bark from two trees of the Burseraceae family (*Protium copal* and *Bursera simaruba*), a pine cone (*Pinus caribaea*), and processed copal incense from highland Guatemala. The amount of similarity between the archaeological and modern samples varies among the cave sites. Samples from all caves share most molecular peaks with pine, followed by trees of the Burseraceae family. All samples show the least affinity with the sample of copal incense obtained from highland Guatemala. Some of the residues may be the resinous bi-product of burning pinewood, a significant factor given the abundance of pine charcoal recovered from the cave sites. Other specimens, especially the sample from Actun Chechem Ha, may be the remains of burned incense made from pine resin and the sap of *Bursera* or *Protium*. The dissimilarity to the specimen of copal incense obtained from highland Guatemala is not surprising. Although copal incense is often made from the sap of trees in the Burseraceae family, especially from *Bursera* in the Maya

highlands (Berlin et al. 1974; Breedlove and Laughlin 2000), the actual botanical components of the incense sample are unknown. Furthermore, the sample was purchased in a local market in highland Guatemala, a substantial distance from the lowland, tropical environment of western Belize.

## Comparison with other Archaeological Sites

### Wood Charcoal

Comparing the wood charcoal assemblage from the cave sites with charcoal collected from other Maya archaeological sites is problematic for several reasons. The primary limitation is the fact that there have been few systematic archaeobotanical investigations at Maya archaeological sites. Another reason is that identifying wood charcoal from the tropics can be difficult due to the high diversity of woody flora in tropical regions. Poor preservation of charcoal can obscure anatomical features necessary for identification. Thus, many researchers choose to focus on identifying non-wood charcoal archaeobotanical remains. Environmental differences among archaeological sites also have a substantial impact on the types of woods that were utilized by the ancient Maya. Dissimilarities between sites' assemblages may reflect environmental characteristics just as much as they reflect cultural differences.

The most notable similarity between the cave sites and other archaeological sites in the Maya region is the abundance of pine versus hardwoods represented in archaeobotanical assemblages. Pine is commonly the dominant genus of wood charcoal recovered from habitation sites, indicating that the burning of pine was a standard economic activity for the ancient Maya. Miksicek (1991) documented extensive reliance on pinewood throughout the Formative period (ca. 1200 B.C.-A.D. 250) at Cuello. The pine charcoal from Cuello is likely Caribbean pine (*Pinus caribaea*), a lowland species that grows along the swampy savanna plains of north-central Belize. The exploitation of pine resources at Cuello varied through time, but it is the dominant genus of wood charcoal overall. Increases in pine remains at Cuello are paralleled by concomitant decreases in wood charcoal from forest trees, suggesting an expansion of savanna land during the Middle Formative period (ca. 650-400 B.C.) due to rising water levels.

Paleoethnobotanical research at Copán, Honduras, has documented a utilization of pine resources similar to Cuello from the Middle Formative period to the Late Classic period (ca. 800 B.C.-A.D. 900) (Lentz 1991). Pine was the dominant wood charcoal from all time periods measured by both ubiquity and weight. Pine charcoal was recovered from many utilitarian contexts including middens, cooking areas, hearths, activity surfaces, construction collapse, and post molds. Pine charcoal was also found in ceremonial contexts, such as tombs and caches. The occurrence of pine charcoal in numerous types of functional contexts suggests that pine was valued

for many purposes by the prehistoric inhabitants of the Copán Valley. Abrams and Rue (1988) and Abrams et al. (1996) have argued that the need for pine for domestic fuel wood greatly outweighed other consumptive wood needs during the Late Classic period at Copán. The intensive exploitation of pine resources led to the rapid deforestation of pine forests in the Copán Valley. This hypothesis is supported by the dominance of pine charcoal over hardwood charcoal in the archaeobotanical assemblage from Copán.

Pine charcoal has been recovered from habitation sites in the Upper Belize Valley, in close proximity to the cave sites (Figure 4.1). Pine charcoal was dominant in Formative period deposits at Cahal Pech and Pacbitun (Wiesen and Lentz 1999). Late Classic period contexts at ancient communities associated with Xunantunich also yielded substantial pine charcoal (Lentz 2001, personal communications). At Pook's Hill, a plazuela group in the Roaring Creek Valley that is near the cave sites discussed in the present study (Figure 4.10), pine remains were particularly prevalent (Morehart 2002a). All sampled archaeological contexts contained pine charcoal (100 %). A wide diversity of contexts contained pine, including middens and construction collapse. Pine charcoal was also found associated with four burials, suggesting that the ceremonial use of pine was not restricted to caves in the Upper Belize Valley. It is noteworthy that hardwoods infrequently occur in the burials, pine being substantially more dominant. Hardwood charcoal was more abundant in middens and other non-ceremonial contexts, though the proportion of pine is still greater.

Pine remains have been recorded from other ceremonial contexts in the Maya region. As previously discussed, pine charcoal was found in tombs and caches at Copán, Honduras (Lentz 1991). Chase and Chase (1998:317) reported that pine needles were found in a cache in Structure A6 at Caracol, in western Belize. It is uncertain if the Caracol remains were examined by a trained archaeobotanist, however, and no further information is available to substantiate this claim. Pine was also recovered from an incense brazier at La Milpa, in northern Belize (David Lentz, personal communication 2001). Excavations in a throne room in Structure 38 at La Milpa's southern acropolis yielded pinewood, radiocarbon dated to AD 770-880, associated with a termination ritual (Hammond et al. 2000:43).

There are a number of reports of pine remains in caves of the Maya Lowlands, indicating that the dominance of pine charcoal from the cave sites in the Upper Belize Valley is not unique. At Actun Polbilche, a cave located in the Sibun River Valley of Belize, 60 specimens of pine splints were found (Pendergast 1974). A sample of the pine was radiocarbon dated to A.D. 625. Pine remains have been found in other cave sites in Belize as well and have been primarily interpreted as the remains of torches (Graham et al. 1980). Gann (1925:111) found a bundle of pine sticks in a cave near Benque Viejo, and pine splints were discovered in Tiger Bay Cave (Graham et al.

1980:169). Stone (1997:201) encountered an unburned pine torch in Footprint Cave, and a possible pine torch was found in Uchentzub (Graham et al. 1980:169). Lastly, Keith Prufer (personal communication 2001) collected pine remains from several caves in the Maya Mountains of western Belize.

In sum, pine was preferred over hardwoods as a wood resource throughout the prehistory of the Maya Lowlands. Pine was probably used mostly as a source of fuel (i.e., domestic firewood, torches, ceremonial burning), though its presence in post molds and construction collapse at Maya sites suggests that pinewood may also have been used as construction materials.

There is no significant difference between the characteristics of the charcoal assemblage from the cave sites and the descriptions of pine from comparative archaeological sites. Pine is commonly the dominant type of wood charcoal recovered from Maya sites. Pine has been obtained from utilitarian contexts at habitation sites and from ceremonial contexts at both habitation and cave sites. It appears, then, that pine was valued for many purposes by the ancient Maya, from everyday economic activities to sacred ritual practices.

### *Maize*

The remains of maize from the cave sites are comparable to maize specimens recovered from archaeological sites throughout the Maya Lowlands. The most significant developmental trend in the cave maize was an increase in size over time, particularly in cupule width. As discussed above, the small maize cupules from Actun Chapat are morphologically similar to Formative period maize recovered from Cuello in northern Belize (Miksicek 1991; Miksicek et al. 1981). Also, the increase in cupule size from Actun Chapat's Unit 10, Level 4 to Unit 10, Level 3 is developmentally parallel to size increases recorded for Cuello's maize. The Late Classic period maize cobs from Barton Creek Cave are substantially larger than Cuello's Formative period maize. If maize from the Late Classic period was available from Cuello, it is probable that Barton Creek Cave's maize would be similar based on the developmental relationship between Actun Chapat and Cuello. The size increase in Barton Creek's maize is likely the result of cultural selection for larger, more productive maize ears, a process that appears to have initiated by the Formative period in the Maya region due to size increases over time at Cuello (Miksicek 1981). Unfortunately, there are insufficient comparative data to determine relationships between the Late Classic period maize from Barton Creek Cave and maize from other Late Classic period sites in the Maya region.

In general, the maize from the cave sites has affinities to maize from other Maya sites. Row number, the most commonly recorded morphological feature, is low for all ancient Maya maize reported, a feature that is shared by the cave specimens. The cave maize has a slightly lower row number than other archaeological examples. Almost



all the cave maize has row numbers of 10. Estimated row numbers from Formative period maize from Cuello range from 10 to 12.9 (Miksicek et al. 1981). Early Classic period maize from Cerén, El Salvador has an average row number of 13.1 (Lentz et al. 1996a:253). Row numbers for Late Classic period maize from Copán were estimated between 12 and 13 (Lentz 1991:272), and Late Classic period maize from Wild Cane Cay, Belize, has 12 rows (McKillop 1994:134-135).

The low row numbers of the cave maize may indicate cultural practices in which specific varieties of maize were selected over maize with higher row numbers for cave rites. Unfortunately, there is no comparative information from neighboring habitation sites in the Upper Belize Valley to assess whether a difference exists between caves and surface sites. On the other hand, the apparent immaturity of the Late Classic period cobs from Actun Chechem Ha suggests that the Maya did select maize with particular attributes for ceremonial offerings for certain occasions. Conversely, the sample size of maize from the cave sites may be too small to support such a hypothesis. Although most of the maize remains have a relatively constant low row number (10), one specimen from Barton Creek Cave has a row number of 12 (Table 5.10). Row number can vary somewhat among individual varieties of maize. Although they are low, the row numbers of the cave maize are within the range recorded for other specimens from the Maya region.

The maize specimens from the cave sites are similar to maize from other Maya sites in terms of presumed associations with contemporary races, suggesting widespread utilization of similar maize types. Bi-variate analysis revealed that the cave maize has affinities to extant races of lowland maize, particularly Nal Tel. The cave data have less similarity to comparative data on highland maize such as Arrocillo. Most maize from Maya archaeological sites has been attributed to modern types of lowland maize, particularly the Chapalote-Nal Tel maize complex. Wellhausen et al. (1952) and Manglesdorf (1974) describe this complex as an ancient, primitive group. Chapalote-Nal Tel is comprised of two maize races, Chapalote and Nal Tel. Both types are composed of short, tapered cobs with narrow rachises and 8 to 12 rows of non-dented kernels. They are found at lower elevations (Benz 1986). Maya sites where Chapalote-Nal Tel maize has been reported include Copán (Lentz 1991), Cuello (Miksicek et al. 1981), Cerén (Lentz et al. 1996a), Altar de Sacrificios, Guatemala (Willey 1972:248), Barton Ramie, Belize (Willey et al. 1965:529), and Pook's Hill, Belize (Morehart 2002a); the latter two sites are in the Upper Belize Valley (see Chapter 2).

Other maize types have been reported also. Some Formative period maize remains from Cuello have morphologies dissimilar to Chapalote-Nal Tel (Miksicek et al. 1981). Miksicek (1986) has identified maize from Santa Leticia, El Salvador, as the race Dzit Bacal. McKillop (1994:134) reported that maize remains from

Wild Cane Cay, Belize, have affinities to Dzit Bacal as well, though no measurements beyond row number are provided making it difficult to evaluate this claim. Both Dzit Bacal and Nal Tel are lowland varieties still grown in the Yucatan peninsula (Benz 1986). Both types mature rapidly, allowing multiple harvests per year, and display morphological similarities, namely low row numbers and narrow rachises. The strong affinities between the two races have led Benz (1986) to include both in the Isthmian Alliance, a phylogenetic group. Wellhausen et al. (1952:146-149) argued that Dzit Bacal originated from the introgression of Nal Tel into another race. Due to these similarities between Nal Tel and Dzit Bacal, classifying archaeological specimens as one or the other may be misleading.

The remains of maize have been recovered from both utilitarian and ceremonial contexts at Maya archaeological sites, indicating that maize, like pine, was a common element of Maya ritual assemblages. The maize remains for Copán discussed above were found in a Late Classic period cache (Lentz 1991). Maize cobs have also been recovered from many cave sites such as Cueva de las Pinturas (Brady et al. 1997) and Naj Tunich (Brady 1989; Brady and Stone 1986) in Petén, Guatemala, Gordon's Cave III, located near Copán, Honduras (Brady 1995), and Mayahak Cab Pek, a rockshelter in the Maya Mountains of Belize (Goldstein and Prufer 1999). No morphological data are available from these cave specimens to compare with data from maize in the Upper Belize Valley caves, however.

In sum, the maize remains from the cave sites in the Upper Belize Valley do not diverge greatly from the characteristics of maize reported from sites throughout the Maya Lowlands. Like maize from other sites, the maize from Barton Creek Cave, Actun Chechem Ha, and Actun Chapat appears to be from a lowland, early-maturing variety of maize, perhaps Nal Tel. The row numbers of the cave maize are somewhat lower than those of other archaeological specimens, however. This difference may be the result of cultural preferences for varieties of maize with low row numbers for ceremonial activities. The immature maize cobs from Actun Chechem Ha substantiate this claim by evidencing that the selection of maize for cave rituals was influenced by ear attributes at least at certain times, possibly for "green" corn ceremonies (see Chapter 6).

## Summary

Archaeobotanical investigations yielded a diversity of plant and organic remains from seven cave sites located in three valleys of the greater Upper Belize Valley. Research focused primarily on macrofloral remains that were obtained through the collection of one-liter flotation samples and from samples of carbonized macrofossils collected during excavations. In addition to macrofloral identifications, starch grain analysis was conducted on soil and residue samples from Actun Chechem Ha. Carbonized residues from Actun Chechem Ha, Barton

Creek Cave, and Actun Nak Beh were subjected to Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) at the National High Magnetic Field Laboratory, Tallahassee, Florida.

Carbonized wood is the dominant type of macroflora recovered from all cave sites. Pine is the most common individual genus of wood charcoal at both the intrasite and intersite levels. Pine was particularly abundant in caves of the Roaring Creek Valley. Pine makes up proportionately less of the caves' charcoal collection as the distance from the Roaring Creek Valley increases. The dominance of pine in caves in the Upper Belize Valley is similar to other sites in the Maya region where pine remains are abundant in archaeobotanical assemblages. The widespread appearance of pine charcoal in both utilitarian and ceremonial contexts suggests that pine was economically and symbolically valued.

A number of botanical foodstuffs are represented in the archaeobotanical assemblage. The only remains from edible fruits that are considered cultural are the nance and cohune tree fruits recovered from the entrance of Actun Nak Beh. The fruit remains from the other caves were probably deposited naturally by bats. Remains of tree fruits, such as cohune palm and nance, from secure archaeological deposits at Actun Nak Beh demonstrate that fruit trees were significant components of ancient Maya life generally.

The remaining botanical foodstuffs consist of charred fragments of domesticated cultigens, including maize, beans, chile peppers, and squash. Maize is the most common domesticated plant, represented by macroflora and microflora (starch grains).

The primary regional trend in the cave maize is chronological. There is an increase in cupule size, namely cupule width, from the earliest deposits at Actun Chapat (Unit 10, Level 4), which may predate the Early Classic period, to the Late Classic period deposits at Barton Creek Cave. The maize cobs from Actun Chechem Ha are substantially smaller than the maize from Barton Creek Cave, even though they are associated with the same time period. The lack of similarity is due to the fact that Chechem Ha's maize cobs are from underdeveloped ears.

Morphological comparisons between the cave maize and maize recovered from other Maya archaeological sites proved difficult because researchers do not commonly record metric data on maize attributes. Useful data are available from the Formative period site of Cuella (Miksicek et al. 1981). The Early Classic period (or earlier) maize from Actun Chapat is similar in size to Formative period maize from Cuella. The increase in size at Chapat between Unit 10, Level 4, and Unit 10, Level 3, is developmentally parallel to that observed at Cuella. The Late Classic period maize specimens from Barton Creek Cave are dissimilar to maize from Cuella, most likely the result of the temporal differences between the two sites.

Maize remains from the cave sites have low row numbers, a characteristic of maize recovered from Maya sites from the Formative period to the Late Classic period. The cave maize specimens have a slightly lower row number, 10, than that recorded for other ancient Maya maize. The constant low row number may be due to cultural practices in which maize ears with lower row numbers were symbolically valued over ears with higher row numbers for ritual offerings. Substantially more data are needed to test this hypothesis, however.

Compared to modern maize races, the caves' maize remains are morphologically most similar to modern lowland races of maize, such as Chapalote, Dzit Bacal, and, most notably, Nal Tel. The maize remains are dissimilar to present-day highland Arrocillo. The maize discussed here is similar to other types of prehistoric Maya maize attributed to lowland races, such as Chapalote-Nal Tel and Dzit Bacal. Based on the current limited evidence, it seems that there was widespread utilization of morphologically similar, perhaps taxonomically related, maize types during Maya prehistory.

Many organic remains were also retrieved from the cave sites. The small, carbonized, cotton textile fragment from Barton Creek Cave is noteworthy. The textile fragment is composed of Z-spun, S-plyed warp and weft elements, woven into a 2 x 2 twill pattern. The textile fragment was associated with a number of well-preserved domesticates found in Barton Creek Cave's Feature 23.

Samples of carbonized residues recovered from Late Classic period deposits at Actun Nak Beh, Actun Chechem Ha, and Barton Creek Cave were subjected to Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry (FT-ICR MS) for molecular comparison with modern reference material. Analysis revealed that all samples share most molecular peaks with pine, followed by trees of the Burseraceae family. All archaeological samples show the least affinity with the sample of modern copal incense obtained from highland Guatemala, a factor that may be due to environmental differences between the highlands and lowlands.

The cave archaeobotanical assemblage included numerous samples from Feature 23 at Barton Creek Cave. Feature 23, a large hearth, was remarkably well-preserved due to a layer of rocks that fell onto its surface. The remains of domesticated cultigens, such as maize, beans, squash, and chile peppers, were recovered from Feature 23. The textile fragment found in Feature 23 may indicate that the cloth was used to wrap the food offerings. Spatial analysis of the macrofloral remains in Feature 23 suggests that the placement of botanical offerings was oriented to the western cave wall. Feature 23 reveals that botanical offerings in caves were more extensive than previously recognized, and that they were a significant component of cave activities.

## CHAPTER 6

### PLANTS AND ANCIENT MAYA CAVE RITUALS

The recovery of a large collection of botanical and organic remains from seven caves in western Belize demonstrates that plants and their products were significant components in the material assemblages of ancient Maya cave rituals. Archaeobotanical materials have rarely been used to reconstruct Maya ritual for two reasons. The first is due to poor preservation of organic remains in the tropical Maya region and the paucity of a database of ancient plant material. The second is a bias towards using botanical data only in reconstructions of environmental conditions and economic adaptations, which may reflect a broader reluctance of archaeologists to reconstruct ritual activity generally.

This study takes a new perspective as well as responds to these restrictions. Unlike surface sites, caves offer an opportunity to examine well-preserved assemblages of plant and organic remains. Although archaeobotanical remains from cave contexts provide insight into economic adaptations, the function of cave activities was predominantly ceremonial throughout Maya prehistory (see Chapter 3). Thus, an interpretative perspective that examines the symbolic aspects of plant utilization is necessary. As with all types of material remains, the function of plants was not necessarily restricted to one task. Plants had multiple uses, and, more significantly, the perceptions surrounding botanical resources were flexible and contingent upon the context of their use.

The data analyzed in this study can be used both to understand the symbolism and ritual surrounding plants and to further elucidate the nature of prehistoric Maya cave activities. This analysis explores ancient Maya symbolic and ritual experience on a regional level, encompassing the Upper Belize Valley. The present approach draws on analogies from ethnography, ethnohistory, iconography, and epigraphy to broaden understanding of cave rituals and the symbolic significance of plants in these activities.

#### Wood Charcoal and Residues

Carbonized wood is the dominant macrofloral remain recovered from all of the cave sites. The simplest explanation for its presence is that the wood was burned for torches because of the necessity for light in the dark interiors of caves, but an examination of Maya culture indicates that symbolism is an essential criterion in the selection of plants used during rituals. Among the ancient Maya, it is likely that the range of fuel wood utilized for ceremonial purposes was influenced by a combination of resource availability, practical concerns like the efficiency of burning and the degree of heat (Metzger and Williams 1966), and symbolic meaning. Explanations that fail to take into consideration the significance of wood charcoal beyond practical concerns, such as illumination, overlook possible cultural meanings behind its utilization.

A number of genera are represented in the charcoal assemblage from the cave sites. The majority of taxa were recovered from only one cave each (48%). One explanation for the high degree of variability is that the utilization of wood resources was the result of resource availability, but the selective harvesting and burning of wood may also have been based on symbolic criteria. Differences in the charcoal assemblage might reflect either differing types of rituals or differing perceptions surrounding plants' symbolic attributes on a regional level. At Actun Chapat, the cave with temporal depth extending from at least the Early Classic period to the Late Classic period, there are significant continuities. Forty-four percent of the charcoal taxa recovered from Unit 10, associated with the Early Classic period, were found in Unit 12, associated with the Late Classic period. The patterns of cave activities reflect long-standing traditions.

#### Pine

Pine (*Pinus* sp.) was the only charcoal genus recovered from all cave sites. Intrasite ubiquity analyses reveal that pine was the most common genus of charcoal at each cave. Early Classic period (perhaps earlier) deposits from Actun Chapat and Actun Nak Beh and Late Classic period deposits at all cave sites yielded pine charcoal, attesting to continuity in customs involving the burning of pine during the Classic period in the Upper Belize Valley. At some cave sites weight measurements indicate that substantially less pine was burned than various genera of hardwoods. For example, 13.58 g of hardwood charcoal versus 0.51 g of pine charcoal were recovered from flotation samples at Actun Chapat. The ubiquity of pine at Actun Chapat is 100%, however, demonstrating that pine burning was a regular activity. Although it was not possible to discern the species of pine recovered from the cave sites, the specimens may be *Pinus oocarpa*, which today grows south of the Belize Valley in the Mountain Pine Ridge.

The frequent occurrence of pine remains in ceremonial contexts at caves and habitation sites in the Maya region indicates that pine burning was a central feature of Maya cave use. As discussed in the previous chapter, carbonized pinewood has been recovered from many caves in Belize utilized by the Maya for ritual activities. Caves where pine has been found include Uchentzab (Graham 1980:169) and an unknown cave near Benque Viejo (Gann 1925:111) in the Upper Belize Valley; Actun Polbilche (Pendergast 1974), Footprint Cave (Stone 1997:201), Cave's Branch Cave (Reents-Budet and MacLeod 1997:58), and Tiger Bay Cave (Graham et al. 1980:169) in the Sibun River Valley; and numerous caves in the Maya Mountains such as Bats'ub/25 Flight Cave, Holomi Baatz Cave, and Xba'qel Xheton Cave (Keith Prufer, personal communication 2001). Habitation sites where pine has been recovered from ceremonial deposits include Late Classic period contexts at Pook's Hill in the Upper Belize Valley (Morehart 2002a), Caracol in the Vaca Plateau of western Belize (Chase and Chase

1998:317), La Milpa in northern Belize (Hammond et al. 2000:43; David Lentz, personal communication 2001), and Copán, Honduras (Lentz 1991:Table 1). The pine remains from Pook's Hill are significant. Pook's Hill is located near many of the cave sites in the Roaring Creek Valley, the region that yielded the largest proportion of pine out of all of the cave sites. Pine charcoal was particularly abundant in burials at Pook's Hill, suggesting that pine was used for multiple ritual activities in the area.

Ethnographic data on modern Maya culture provide information to interpret the symbolic significance of pine in ancient Maya society. Among the present-day Tzotzil Maya of Highland Chiapas, Mexico, pine, or *ocote*, is one of the most prominent ritual plants (Vogt 1969, 1976). Pines symbolically represent the Tzotzil domain *te'tik*, trees or forest, thereby associating pine with the wild and undomesticated realm of nature (Vogt 1976:6). Pine needles, known as *shak toh*, from the species *Pinus montzumae*, are placed along the bases of crosses as well as over the floors of churches. Standing on the pine needles during rites facilitates communication with the deities (Vogt 1969:393). The Tzotzil Maya attach pine boughs to the crosses erected on sacred shrines. These cross-shrines are believed to be "doorways" to the houses of deities (Vogt 1976:6). The Tzeltal Maya, also residing in Highland Chiapas, and the Quiché Maya of Highland Guatemala have similar practices involving pine (Berlin et al. 1974; Lothrop 1929), and pine needles and pine boughs are characteristic paraphernalia of house altars of many Maya groups (Deal 1988).

The tapped resin and resinous wood of pine may be used for incense; when burned, the combustion of volatile oils and turpenes in the oleoresin creates a pleasant aroma. Some Lowland Maya groups in Guatemala and Mexico use pine resin in this manner, such as the Itzaj of Petén, Guatemala (Atran and Ucan Ek' 1999:Table 2.2), and the Lacandon of Lowland Chiapas, Mexico (McGee 1990:44) (see below for a discussion of the nature of copal incense). The Lacandon pound the resin into a paste and store it in "god houses," thatched roofed huts that are loci for rituals and storage places for ritual objects. In Highland Guatemala, one can purchase splints of pine for kindling copal in local markets.

The archaeological evidence from Actun Chechem Ha, Barton Creek Cave, and Actun Nak Beh supports the idea that pine resin was used for incense in caves of the Upper Belize Valley during the Late Classic period. All carbonized residue samples subjected to Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry have greater similarity to pine than to other comparative material. Although some of these residues may actually be the resinous bi-product of burning pinewood, as at Actun Nak Beh, it is probable that some specimens are the remains of incense with pine resin as a principal ingredient.

Researchers have recorded the ceremonial burning of pinewood by the modern Maya. The Chuj Maya of San

Mateo Ixtatán, Guatemala, burn pine shavings as offerings in front of churches during ritual prayers (Nicholas Hopkins 2001, personal communication), and pine chips are often burned at household altars in many Maya communities (Deal 1988). Thompson (1970:172) described rites in which individuals blacken their faces with soot from pine charcoal in preparation for auto-sacrifice.

There are ethnographic and ethnohistoric accounts that suggest that the pine charcoal from the cave sites is the remains of torch offerings. Tedlock (1982:149) observed that the Quiché Maya use pine torches in cave ceremonies. Seventeenth century documents written by Spanish friars, Bartolomé de Fuensalida, Juan de Orbita, and Joseph Delgado, recorded pine torches as ritual offerings of the Manche Chol Maya of Belize (Thompson 1988:46). Pottery torch holders, ceramic tubes that are flared on one end and closed on the other, which possibly held pinewood, have been recovered from many cave sites in the Maya Lowlands (Brady 1989:257-258; Graham et al. 1980:169; Stone 1997:201).

The Popul Vuh, the Quiché book of creation, provides an account of the significance of burning torches in caves (Tedlock 1985:112-113, 137). The Lords of *Xibalba* subject the fathers of the Hero Twins, One Hunahpu and Seven Hunahpu, to a series of trials. The first trial took place in an underworld realm called the "Dark House." The Lords of *Xibalba* gave the mythological figures each a cigar and both a single burning torch with the instruction that they must be returned in the morning unfinished. One Hunahpu and Seven Hunahpu finished the cigars and the torch, failed the trial, and, thus, were sacrificed by the Lords of *Xibalba* as punishment. One Hunahpu and Seven Hunahpu's sons, the Hero Twins, were also put through a series of tests in *Xibalba*. They were not tricked by the *Xibalban* lords, however. They put the tail feathers of the macaw on the torch and fireflies on the cigars to imitate fire, and the Hero Twins successfully passed the underworld trial.

Ethnographic analogies from the Maya Highlands suggest a relationship between the prehistoric ceremonial burning of pine torches and the modern use of candles. Among the Tzotzil, the general term for pine is *toj* (Breedlove and Laughlin 1993, 2000), which corresponds to the Chuj name, *táx* (Breedlove and Hopkins 1971:194), and the Tzeltal name, *tah* (Berlin et al. 1974). During Tzotzil ritual speech, candles are referred to as "*j-sil yo jtoj, j-sil yo jkantela*, a splinter of my lowly [pine] torch, a shaving of my humble candle" (Breedlove and Laughlin 2000:183). Similar prayers are common in other Tzotzil ceremonies (Vogt 1976:53, 54, 77, 105, 183). This linguistic example reveals that candles and pine torches are perceived as semantically parallel sets of objects. The similarity between pine and candles is likely because pine torches are an ancient analogue to the modern day use of candles (Morehart 2001, 2002b), a position also proposed by Vogt (1976:105; see also Bassie-Sweet 2000:11-12). Indeed, the Classic Maya sign for *taj* is a flaming bundle



Figure 6.1: Classic Maya sign for *taj*, represented by a bundle of burning pine faggots (redrawn from Coe and Stone:2001:165).

of pine splints (Coe and Stone 2001:165; see also Stuart 1987) (Figure 6.1).

Several Classic period iconographic representations document the use of *taj*-torches such as Stela 35 at Naranjo and Lintel 24 at Yaxchilan, Mexico (Martin and Grube 2001:82, 125). The paintings of Joljá Cave, in Chiapas, Mexico (Bassie-Sweet et al. 2000; Stone 1989), depict the use of torches during cave rituals, supporting the interpretation that pine charcoal from cave sites is the remnants of torches. Landa (Tozzer 1941) described similar uses of bundled torches during new fire ceremonies, called *suhuy kak*, by the sixteenth century Yucatec Maya. During the month Mac, a new fire rite was undertaken in honor of rain and agricultural gods in which “[t]hey placed in the middle [of the court] a great faggot of dry sticks tied together and set upright, and first burning some of their incense in the brazier they set fire to the stick” (Tozzer 1941:163). New or virgin fire rites are still practiced by the modern Lacandon Maya of Chiapas, Mexico (McGee 1990:53; Tozzer 1941:759), where the fires are lit to kindle incense and to purify paraphernalia used during ceremonies. The Huastec Maya use similar bound sticks of pine branches, known as *pithomlaab*, during curing rites (Alcorn 1984:228, 229, 913).

Other parallels involving pine substantiate the suggestion that the ancient ceremonial burning of pine torches is analogous to the modern burning of candles. For many Lowland Maya groups, black candles are valued for rituals. The Chorti Maya use black candles in traditional, native ceremonies, while white candles are used for ceremonies associated with the church (Wisdom 1940:381). Among the Kekchi and Mopan Maya of southern Belize, black wax candles are sacred, whereas white candles have no symbolic value (Thompson 1930:105). The Mopan and Kekchi Maya have a myth that fire was first brought to them by a dog that carried a black candle, and, since then, they have never been without fire (Thompson 1930:151). If pine torches were used in antiquity for the same purposes that candles are used today, linguistic data offer a possible explanation for the significance of black candles. In highland and lowland Mayan languages, the terms for pine and obsidian, *tah*,

*toj*, *cha*, or *chaj*, are homophones (Schele and Miller 1983:10-11). Obsidian is a black, volcanic glass that Mesoamerican groups fashioned into many utilitarian and ceremonial objects (Clark 2001). The ancient Maya believed that obsidian was sacred; obsidian is associated with the spirit of lightning and with fire (Bassie-Sweet 1991:117, 1996:15), emphasizing a relationship with sources of fire such as torches. Fire can also be created by igniting a spark by striking a stone or by concentrating light reflected from obsidian mirrors. In short, if the ancient burning of pine is equivalent to the modern burning of candles, the homophonous relationship between pine and sacred, black obsidian may account for why some contemporary Lowland Maya groups believe that black candles are sacred.

The homophonous relationship between pine torches and obsidian is evident in Classic period iconography (Schele and Miller 1983). The Classic Maya deity God K, also known as *k’awil*, who is associated with lightning and rulership (Bassie-Sweet 1996:55-56, 182-183), is depicted with a mirror on his forehead. Iconographic and epigraphic evidence suggests that the mirror is made from obsidian. One way the Maya indicated that the mirror was obsidian was by showing a smoking celt or axe protruding from it. The axe motif is related to lightning and, thus, obsidian (Bassie-Sweet 1996:55).

Another way the Maya illustrated that the mirror is of obsidian was by depicting the protruding object as the flaming *taj*-torch sign discussed above, stressing its homophony. According to Schele and Miller (1983:11-12, emphasis added):

The mirror forehead of God K can, then, appear with an *ocote torch*, with smoke (or flames), a ceramic torch holder with smoke, with a smoking cigar, or with a smoking celt. The mirror attachments all seem to function as phonetic complements to insure that the mirror is understood to be made of obsidian.

Candles are standard paraphernalia in the ritual assemblages among modern Maya groups (Josserand and Hopkins 1996; Love and Peraza Castillo 1984; McGee 1990; Oakes 1951; Redfield and Villa Rojas 1934; Tedlock 1982; Thompson 1930; Vogt 1976; Wisdom 1940) (Figure 6.3). The Yucatec Maya believe that melting candle wax is *itz*, a holy substance or “cosmic sap” (Freidel et al. 1993:210). For the Chol Maya, candles are linguistically associated with flowers (Josserand and Hopkins 1996). Flowers are called *nich*, whereas candles are referred to as *nichim*.



Figure 6.2: A modern Yucatec Maya church located in Naranjal, Quintana Roo, Mexico, showing numerous candles on altars.

The ancient burning of pine can be interpreted as symbolic food offerings based on ethnographic accounts of the significance of candles. Modern Maya groups refer to candles as sacrificial food for the deities. Candles can symbolize animal meat and human sacrifice (Vogt 1976:46-50). In addition, white candles have associations with maize and tortillas for the Tzotzil Maya; they are “tortillas for the gods” (Vogt 1976:50). The Tzotzil Maya place or “plant” candles in the ground in a manner that is reminiscent of a farmer planting maize, creating a circular network of symbols: “tortillas are made from maize; maize grows with the heat provided by the sun; candles produce heat energy—hence the symbolic relation of tortilla-maize-candle” (Vogt 1976:50). Taube (1995:89, 1996:68) has suggested that Formative period iconography that is structurally similar to the Classic period Maya *taj* glyph is related to maize symbolism.

Although ubiquity values indicate that pine was the most common charcoal genus at the Upper Belize Valley cave sites, intersite weight comparisons demonstrate that the proportion of pine in the charcoal assemblages declines the greater the distance from the Roaring Creek Valley, particularly from the site of Cahal Uitz Na. At Actun Nak Beh, 98% of the charcoal assemblage is composed of pine, whereas only 1% is made up of hardwoods. A similar distribution between pine and hardwood charcoal was recovered from Twin Caves 2. Caves outside of the Roaring Creek Valley have substantially less pine. For example, pine composes only 4% of Actun Chapat’s charcoal collection. At Barton Creek Cave, which is closer to the Roaring Creek Valley, only 17% of the charcoal assemblage is pine.

Pine was also valued for utilitarian functions such as domestic fuel wood and construction. Pine has been the preferred fuel wood in Mesoamerica since the Middle Formative period (Flannery 1986:169-170; Miksicek 1991:Figure 4.3; Wiesen and Lentz 1999); it is often the

most common genus of wood charcoal recovered from both ceremonial and non-ceremonial contexts. The ubiquitous nature of pine remains at sites in the Maya lowlands suggests that pine products were probably trade goods in ancient Maya exchange systems (Lentz 1999:14). The role of pine as a trade good was observed by J.E.S. Thompson (1970:146), who stated that “*Ocote* (pitch pine)...is more plentiful in the highlands than in parts of the lowlands, notably much of the Usumacinta drainage, to which sticks may have been shipped, but the central Petén probably drew on supplies from the Pine Ridge land of British Honduras.”

The differential distribution of pine remains from the cave sites may suggest economic inequalities in the Upper Belize Valley. The caves in the Roaring Creek Valley are in a closer proximity to modern sources of pine forest than most other cave sites (Figure 6.3). But geography alone cannot adequately explain the differential distribution of pine remains among the caves. Barton Creek Cave, like Actun Nak Beh, is near pine sources. The contribution of pine in Barton Creek Cave’s charcoal assemblage is much less than that recovered from the Roaring Creek caves, however.

Lentz et al. (2005) hypothesized that trade in pine products was a centrally controlled or restricted system during the Late Classic period in the Upper Belize Valley. They observed that in the Xunantunich area, pine remains are significantly more abundant in ancient structures associated with groups of higher social and economic standing, even if structures of lower status groups are geographically closer to modern pine sources. The archaeobotanical data from the cave sites support their hypothesis. Pine remains are substantially more abundant in caves associated with or close to Cahal Uitz Na, the dominant organizational center during the Late Classic period Roaring Creek Valley (Awe and Helmke 1998). Actun Chechem Ha, the only cave outside of the Roaring



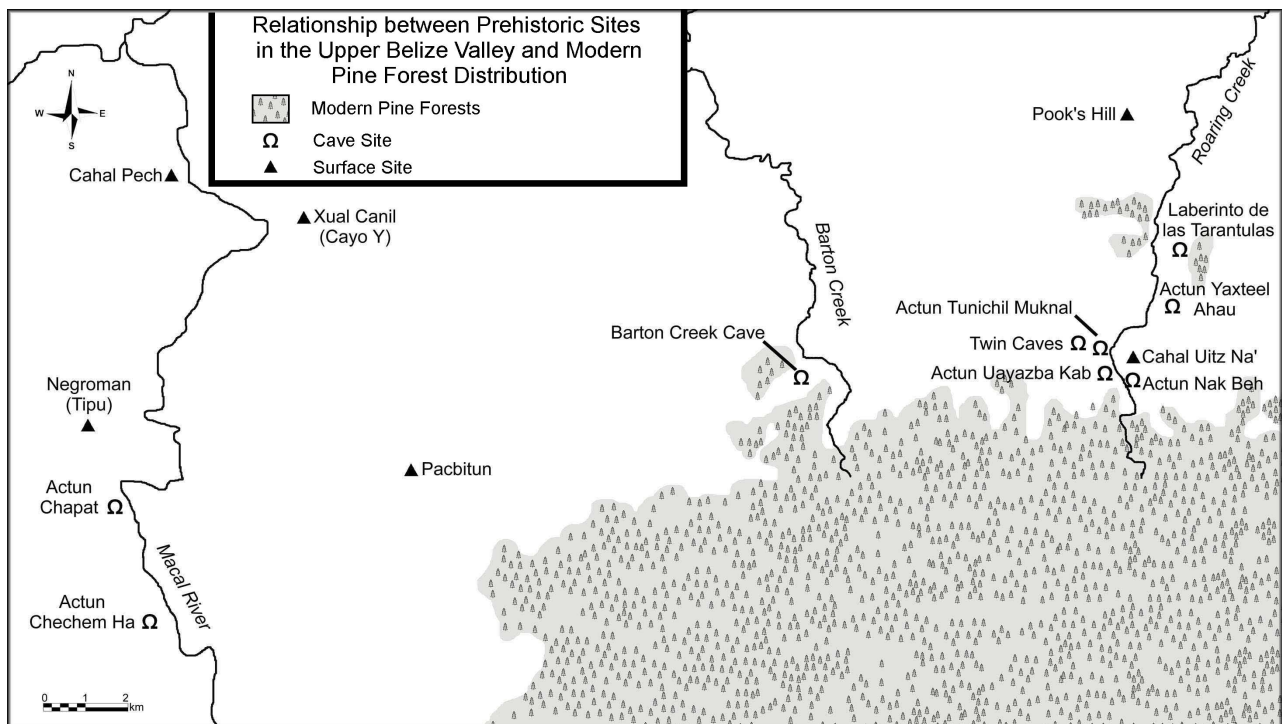


Figure 6.3. Location of key archaeological sites in relation to contemporary pine populations.



Figure 6.4: Mountain Pine Ridge, Cayo District, Belize.

Creek Valley with a dominance of pine charcoal, has other material remains that associate it with groups of high social standing, such as polychrome vessels and a limestone monument or “stela” (Ishihara 2000:48).

Charcoal data from Actun Chapat suggest that the restricted access to pine resources was a temporally late phenomenon. From the Early Classic period to the Late Classic period, the proportion of pine in Actun Chapat’s charcoal assemblage experiences a sharp decrease from 31% to 2%. This pattern suggests that as population densities grew in the Upper Belize Valley during the Late Classic period, as evidenced by an increase in house

mounds and the reliance on terrace-based agriculture (Fedick 1989, 1994, 1995; Ford and Fedick 1992), local sources of wood were likely being depleted due to forest clearance for intensive and expansive agriculture, the need for construction materials and fuel wood, and the need for available living space. Similar human-induced environmental stress has been observed at prehistoric sites throughout the Maya lowlands (Abrams and Rue 1988; Abrams et al. 1996; Rice 1978, 1993; Tsukada 1966; Wiseman 1978).

The depletion of local wood sources probably forced the Maya to focus on biological products in regions that were

not as densely populated, such as the Mountain Pine Ridge area of the Maya Mountains and its northern extension into the upper Roaring Creek and Barton Creek valleys (Figure 6.4). Securing preferential access to pine, a wood that has been the preferred source of fuel wood in the Maya region since the Formative period, would have been economically advantageous for high status groups in the Upper Belize Valley. Other goods from the Maya Mountains that may have been harnessed by elite groups include pyrite for mirrors, greenstone for ornaments (Dunham 1996), and slate (Healy et al. 1995).

The abundance of pine charcoal from caves associated with Cahal Uitz Na, especially Actun Nak Beh, may suggest that the pine trade was one of Cahal Uitz Na's principal economic concerns, though no botanical data are available from Cahal Uitz Na itself. Establishing exclusive access to sources of supply assists in maintaining local authority (Hirth 1992:21) and can generate inter-polity cooperation and alliances between the leaders of politically competitive communities (Freidel 1979:51). Although many models of Maya social stratification are based on the control and exchange of prestige goods rather than utilitarian products (i.e., Ball 1993; Brumfiel and Earle 1987; Demarest 1992; Hirth 1992), the use of pine was not limited to basic economic functions. The burning of pine was a standard feature of ancient Maya ritual as evidenced by the present cave data and by comparative data from other caves in Belize and from ceremonial contexts at surface sites throughout the Maya Lowlands. In short, the location of Cahal Uitz Na in close proximity to sources of pine forest may have provided the rulers of the site with greater access to economic surpluses, giving them the ability to undertake politically charged ceremonial enterprises, a "fund of power" (Sahlins 1968:89).

### Copal

*Protium* is another genus of wood charcoal found at the cave sites that has been abundantly documented in the ethnographic and ethnohistoric record. *Protium* sp. charcoal was recovered from Barton Creek Cave and Actun Chapat. At Barton Creek Cave, *Protium*, together with *Piscidia* sp., was the second most ubiquitous genus of hardwood charcoal, and it was the dominant charcoal by weight. *Protium* sp. was less abundant at Actun Chapat, but it was recovered from deposits dating from the Early Classic period to the Late Classic period.

The Lowland Maya have used the sap from species of *Protium*, known as the copal tree, for incense for centuries. The burning of incense is a standard element of most ritual activities among contemporary and conquest period Mesoamerican groups, including agricultural rituals, lineage rituals, healing rituals, funerary rituals, and domestic rituals (Alcorn 1984; Breedlove and Laughlin 1993, 2000; Oakes 1951; Redfield and Villa Rojas 1934; Roys 1931; Stross 1997; Tozzer 1941; Vogt 1969; Wisdom 1940). Like candle wax, the sap of incense-yielding trees is considered sacred (Friedel et al.

1993:210-211). Stross (1997) has proposed that the inhalation of copal smoke may have enabled Mesoamerican shamans to enter trance-like states.

Ethnographic sources reveal that the aromatic smoke produced by burning copal incense is a symbolic sacrifice or "food" offering that is consumed by the deities (see Chapter 2). The Tzotzil Maya believe that copal is cigarettes for the gods (Vogt 1976:49), and the Lacandon Maya believe that as the incense burns it transforms into tortillas that are consumed by deities (McGee 1990:44). Some Maya groups, such as the Chorti Maya of Guatemala (Wisdom 1940:387), form balls of copal into maize cobs and offer them to the gods. Nodules of copal wrapped in maize husks can be purchased in local markets in highland and lowland Guatemala, emphasizing its association with maize and, thus, food (see also Stross 1997).

There are substantial ambiguities of the botanical meaning of copal in many archaeological and anthropological reports (see Stross 1997). Much of the confusion is due to the assumption that copal refers to the sap of one specific tree, *Protium* sp.. It does not. Copal, or *pom*, more accurately refers to a general category of incense or to trees that produce incense. The physical properties that determine whether a particular plant's sap can be used for incense include burning quality, thick black smoke, and aroma. There are a number of trees that produce sap with these characteristics, and the sap of different trees is often mixed together to form the final product.

Most trees used for incense in Mesoamerica belong to the family Burseraceae, particularly species of *Protium* or the closely related genus *Bursera*, known in Yucatec Mayan as *chakah* or *chakchakah* (Barrera Marin et al. 1976:303) and in local Creole as gumbo-limbo. Among highland Maya groups, such as the Tzotzil and Tzeltal Maya, *Burseras* are the primary sources of incense (Berlin et al. 1974; Breedlove and Laughlin 1993:, 2000:179). A number of charcoal specimens recovered from the cave sites were only identified to the family Burseraceae (see Chapter 5). Although their genus is currently unknown, they may be the remains of a species of *Bursera*. Archaeological residue samples subjected to Fourier Transform-Ion Cyclotron Resonance Mass Spectrometry displayed greater similarity to comparative specimens of *Bursera simaruba* than to *Protium copal*.

Species of *Bursera* have other ritual uses in addition to incense. During the *ch'a chaak* rite, *chakah* wood is used to make a wooden knife held by the impersonator of *k'unk'uchaak*, the principal rain god. The wooden knife, or *lelem*, represents the object used by the rain gods to produce lightning (Barrera Marin et al. 1976:303; Redfield and Villa Rojas 1934:142). The stems of *chakah* are also used to construct the *ch'a chaak's* main altar (Flores and Balam 1997:Table 1).



Copal incense can be made from the sap or bark of other trees, and copal is frequently composed of resin from multiple taxa. Breedlove and Laughlin (2000:179) report that the sap from *Enterolobium cyclocarpum*, known in Spanish as guanacaste, is sometimes mixed with resin from *Bursera* sp. Charcoal from a species of *Enterolobium* was collected from Tarantula Cave. The Tzotzil Maya identify *Zanthoxylum mayanum* as similar to *Bursera excelsa* and *Bursera bipinnata*, both of which are used as sources of incense (Breedlove and Laughlin 2000:179). A species of *Zanthoxylum* was recovered from Late Classic period contexts at Barton Creek Cave and Actun Chapat. The Yucatec Maya sometimes make crosses from the wood of *Zanthoxylum*, known as *tankasche*, also (Barrera Marin et al. 1976:310). Furthermore, mass spectrometry of carbonized residues from the cave sites revealed affinities to chemical compounds found trees in the Burseraceae family and pine, suggesting that the ancient Maya of the Upper Belize Valley used the sap from multiple trees to make incense.

Archaeological research at habitation sites in the Maya Lowlands has yielded evidence, both carbonized residues and wood charcoal, that the Maya utilized copal-yielding trees throughout their prehistory. Formative period contexts at Cahal Pech (Aimers et al. 2000:75) and Cerros (Cliff and Crane 1989:Table 2), both located in Belize, and Late Classic period contexts at Altar de Sacrificios, Guatemala (Willey 1972:248), have yielded the remains of charred residues that have been interpreted as copal. Carbonized *Protium copal* wood was found in Formative period contexts at Albion Island (Miksicek 1990:Table 10.1) and in Late Classic period contexts at Pulltrouser Swamp (Miksicek 1983:102) and Copán (Turner and Miksicek 1984:185). *Bursera* wood was recovered from Formative period deposits at Cuello (Miksicek et al. 1991:Table 4.1) and from Late Classic period contexts at Dos Pilas (Lentz 1999:Table 1), Cobá (Beltrán Frias 1987:228), and Santa Leticia (Miksicek 1986:199).

Although wood charcoal remains allow more accurate identification of taxa than carbonized residues, wood provides only indirect evidence that the material was used for incense because wood has a number of uses such as fuel and construction materials. Furthermore, the sap from copal-yielding trees can be utilized for other purposes such as medicine and glue (Alcorn 1984:763; Arnason et al. 1980:Table 1; Arvigo and Balick 1993:57; Atran and Ucan Ek' 1999:Table 2.2; Comerfield 1996:333). Garza-Valdes discovered that the resin of *Bursera bipinnata* was used to bind pigments in the Late Classic period murals of Bonampak, in Chiapas, Mexico (cited in Stross 1997:184).

The remains of copal incense are frequently reported from caves. Brady (1989:212-213) tested ceramic sherds from Naj Tunich, Guatemala, with unknown residues by heating the artifacts in an oven. The aromatic smoke that was produced was subjectively described as copal. These tests demonstrated that every domestic ceramic type from

Naj Tunich used to burn incense. Reents-Budet and MacLeod (1997:60) made a similar observation about many ceramic sherds from Petroglyph Cave, Belize, that showed evidence of burned residue. A small ball of copal was also recovered from Petroglyph Cave (Reents-Budet and MacLeod 1997:60), and the residue of copal was found adhering to a modified stalagmite in Río Frio Cave, Belize (Pendergast 1970:8). Finally, 160 specimens of copal offerings were dredged from the Cenote de Sacrificios, near Chichen Itza in Yucatan, Mexico (Coggins and Ladd 1992). Many of these are still in their original offering plates, and others are in the shape of anthropomorphic figures. Jade and shell beads adhere to the surfaces of some specimens. Others have leaf and maize cob impressions, revealing continuity in the association between copal and maize that is still held by modern Maya groups such as the Chorti and Lacandon Maya.

### *Balche'*

*Lonchocarpus*, another notable hardwood genus recovered from the cave sites, is a component of modern Maya ritual assemblages. Both Actun Halal and Barton Creek Cave yielded *Lonchocarpus* charcoal. The *Lonchocarpus* remains at Actun Halal are scarce, approximately 0.01 g, and are problematic due to the disturbed contexts at the site. *Lonchocarpus* charcoal is more abundant at Barton Creek Cave. It is the fifth most common hardwood at the site, although weight measurements suggest that little was burned.

Among the Yucatec Maya, species of *Lonchocarpus* are known as *balche'*. *Balche'* is the source of an alcoholic beverage consumed during rituals. *Balche'* is made by pounding pieces of bark from the *Lonchocarpus* tree and allowing them to soak with water and honey for a period of days until the mixture ferments (McGee 1991:443; Redfield and Villa Rojas 1934:38; Roys 1931:216; Thompson 1930:104). Landa (Tozzer 1941:64) recorded that the sixteenth century Yucatec Maya maintained orchards or "improved lands" planted with *balche'* trees.

*Balche'* is consumed by ceremonial practitioners and is offered to deities. In the ethnohistoric Yucatec Maya text *The Book of Chilam Balam of Chumayel* (Roys 1967:92), it is stated that "God shall be first...He is the true ruler, he shall come to demand us our government, those things which we hold sacred...he shall demand the planted wine, the *balche'*." For the modern Yucatec Maya, *balche'* is considered "cold" and *zuhuy*, virginal or holy, thus effective in dealing with the gods (Redfield and Villa Rojas 1934:131). The drinking of *balche'* purifies the body and soul, assists ritual practitioners in attaining a transcendental state, and is a preferred offering for deities (McGee 1987; 1991:440). Among the Lacandon Maya, the *balche'* rite functions as a reassertion of traditional faith and promotes community cohesion (McGee 1991:452). The Lacandon Maya employ *balche'* rituals for a number of reasons but primarily to invoke the gods'

aid in lieu of misfortune such as illness or crop failure (see also Barrera Marin et al. 1976:302).

It is difficult to associate the archaeobotanical remains of *Lonchocarpus* from the cave sites with the production, consumption, and offering of *balche*. Although *balche* storage has been suggested as a possible function of large ceramic vessels found in some cave sites (Ishihara 2001b), the charred nature of the wood indicates another function, ceremonial burning. It is possible that the *Lonchocarpus* remains are the waste or by-product of *balche* offered to deities and consumed by ritual practitioners. Conversely, the sacredness of the *balche* tree was possibly great enough that its use could extend to other ceremonial functions.

### Cacao

*Theobroma* is another genus of hardwood charcoal that warrants discussion, though its contribution to the charcoal assemblage is small. *Theobroma* charcoal was only recovered from Feature 23 at Barton Creek Cave, which contained remarkably well preserved plant and organic material. The *Theobroma* charcoal is from underdeveloped wood, suggesting that it is from an immature stem or a branch.

Iconographic, archaeological, ethnographic, and ethnohistoric documentations of *Theobroma* are extensive (Chapter 2). *Theobroma*, known as cacao, was a symbolically significant plant (Coe 2001; Coe and Coe 1996). Its seeds or beans, are roasted, ground, and made into a chocolate beverage that was ceremonially consumed for ritual events, such as feasts, throughout Mesoamerica. Cacao contains the alkaloids theobromine and caffeine, making chocolate a stimulating drink. Its beans were also a form of currency at the time of Spanish contact. The consumption of chocolate drinks appears to have been restricted to higher status groups during ancient Maya society. The Primary Standard Sequence on many Classic period polychrome vessels has been deciphered as “a drinking vessel for cacao” (Coe 2001:138). Chemical analyses of residue on vessels from Río Azul, Guatemala, and Colha, Belize, indicated that the vessels were used as containers for chocolate drinks (Hurst et al. 1989; Powis et al. 2002). Ethnohistoric records documented sixteenth century Yucatec Maya cacao cultivation in orchards, and the elite consumed cacao during feasts and offered it to the gods (Tozzer 1941:92).

*Theobroma* charcoal remains from Barton Creek Cave do not indicate that a cacao beverage was ceremonially deposited in the cave, although it does provide evidence that cacao was utilized and may have been symbolically valued for multiple purposes. It is possible that the cacao branch was attached to a fruit. No *Theobroma* fruit or seed remains were recovered from Feature 23, however. This factor, in conjunction with Feature 23’s remarkable preservation and the large number of samples collected from it, makes it unlikely that cacao fruits were deposited as offerings.

### Spanish Cedar

Spanish cedar (*Cedrela* sp.) is another hardwood genus recovered from both Actun Chapat and Barton Creek Cave that has ethnographic and ethnohistoric accounts of its use during ritual activities. At Actun Chapat, *Cedrela* is associated with the Early Classic period, while it was recovered from Late Classic period deposits at Barton Creek Cave, demonstrating a lengthy reliance on the wood for ceremonial purposes in the Upper Belize Valley.

Barrera Marin et al. (1976:307) recorded that branches of *Cedrela*, known as *k’uche*, can substitute for branches of *sipche* (*Bunchosia swartziana*) during the Yucatec Maya ceremony *santiguar*, “to be sanctified”. The *santiguar* rite, a purification and cleansing ritual, is performed by shamans in order to cure an illness that is caused by evil winds (Redfield and Villa Rojas 1934:173). The *santiguar* depends on the power that certain plants have to cleanse the patient.

*Cedrela* wood is used to make sacred idols that the Maya worship. Species of *Cedrela* are known as *ch’u-te*, “god tree,” by the Tzotzil Maya (Breedlove and Laughlin 2000:177). The Tzotzil believe that cedar has divine properties because of the wood’s constant aroma, and the wood is utilized to make crosses as well as carvings of patron saints. The Yucatec Mayan name for cedars, *k’uche*, also means god tree (Roys 1931:258). Landa recorded that the sixteenth century Yucatec Maya always made their idols from cedar wood (Tozzer 1941:160). This use is attested archaeologically. A figurine made from Spanish Cedar was recovered from Xmuclebal Xheton, a cave in the Maya Mountains of Belize (Pruffer 2001). The figurine is shaped like a Manikin Scepter, an ancient Maya symbol of divine rulership (Coggins 1988:143).

### *Habín, Tzalam, and Bohom*

Ethnographic and ethnohistoric documentation on the ritual use of other genera of hardwood charcoal recovered from the cave sites suggests continuity in the ceremonial significance of these taxa. For example, Redfield and Villa Rojas (1934:144; see also Marin et al. 1976:302-311) describe the ceremonial burning of wood and bark in the earth oven, or *pib*, during first fruit ceremonies among the Yucatec Maya. The *pib* is used to roast sacrificial food that is offered to deities. Redfield and Villa Rojas (1934:144) state “[w]hen the stones have become hot, upon them are laid bark of *habín* and *chóy* or of *tzalam* and *bohom*.” *Habín* is *Piscidia* sp. (Barrera Marin et al. 1976:304). *Tzalam* and *bohom* are species of *Lysiloma* and *Cordia*, respectively (Roys 1931:217, 290). The taxonomic affiliation of *chóy* is more uncertain, though it may be a species of *Cochlospermum* (Barrera Marin et al. 1976:304).

Three of these genera, *Cordia*, *Lysiloma*, and *Piscidia*, are represented in the cave assemblages. *Piscidia* was recovered from Actun Chapat and from Barton Creek

Cave. At Barton Creek Cave, *Piscidia* is the second most abundant charcoal taxa measured both by weight and ubiquity. *Lysiloma* was also found at Barton Creek Cave, but in a substantially reduced amount. *Cordia* was recovered from Actun Chapat and Tarantula Cave; at Tarantula Cave, it was the dominant wood charcoal.

Other scholars have recorded the use of all three genera in earth ovens during the *ch'a chaak* rite, a traditional rain ceremony in which the *chacs* or rain gods are invoked during times of drought (Flores and Balam 1997:Table 1; Barrera Marin et al. 1976:303, 304, 311). Their utilization is not limited to burning in the *ch'a chaak*'s earth oven, however. Branches of *Lysiloma*, *tzalam*, are used to stir the coals of the *pib* and to construct the ceremonial altar that holds ritual paraphernalia (Flores and Balam 1997:Table 1). Barrera Marin et al. (1976:305; see also Redfield and Villa Rojas 1934:141) recorded that during *ch'a chaak* rites branches of *habín* are placed around the cross to protect it from the sun's rays. *Habín* is also used to construct the altar that holds the cross during the *ch'a chaak* (Flores and Balam 1997:105). The Yucatec Maya use *habín* during rain ceremonies because its yearly flowering and shedding of leaves indicates the rainy and dry seasons, respectively. Furthermore, *habín* is considered a "cold" tree, or *ziz-che*, in the Yucatec Maya humoral system because it grows near cenotes and remains green longer than other plants (Redfield and Villa Rojas 1934:130). It is, as are all cold things, related to moisture. The Huastec Maya also associate *Piscidia*, known as *tsi'hol*, with rain. Thus, *habín* has an inherent relationship with water, making it an appropriate plant symbol to use during rain ceremonies.

### Botanical Food Remains

The archaeobotanical assemblages from the cave sites contain many well preserved remains of botanical food items. The remains of domesticated plants, such as maize, beans, squash, and chile peppers, were recovered from Barton Creek Cave, Actun Chapat, and Actun Chechem Ha. The remains of tree fruits, nance and cohune, were recovered from Actun Nak Beh. The offering of food to deities and ancestors as symbolic "payments" is a common characteristic of Maya ceremonial activities (Chapter 2). Although both the domesticated crops and the tree fruits served as food offerings, they were taxonomically and symbolically distinct. An examination of the characteristics of the food remains, in light of their archaeological contexts, reveals possible differences in their symbolic significance to ancient Maya ritual practitioners. These differences suggest qualitative variations in the utilization of caves in the Upper Belize Valley.

#### Domesticated Crops

Domesticated crops were found only from the dark interiors of Barton Creek Cave, Actun Chechem Ha, and Actun Chapat. These caves are not associated with any specific ceremonial center, as is Actun Nak Beh, and can

be characterized as rural caves. I suggest that these sites were the location for rites conducted to appease gods directly associated with agricultural fecundity. Among the contemporary Maya, maize is believed to have had a subterranean origin (Thompson 1970:348-354), and iconography from the Classic period often depicts the Maize God's resurrection from a fissure in the earth's surface. Modern Maya groups believe that caves are the dwelling places of deities associated with rain and agriculture, and rituals are conducted at their entrances to ensure a productive harvest (see Chapter 3).

The concept that powerful earth deities reside in caves, cenotes, and mountains is pan-Mayan (Alcorn 1984; Guzmán et al. 1980; Gossen 1974; Josserand and Hopkins 1996; Redfield and Villa Rojas 1934; Thompson 1930; Vogt 1969, 1976; Wisdom 1940). There is a central belief that in order to use the products of the earth and maintain agricultural productivity proper rituals must be made to acquire the earth deities' permission prior to planting and to repay them for use of their domain after harvest. During maize-field ceremonies, for example, the Tzotzil Maya of Zinacantan, Chiapas, Mexico, make pilgrimages to the caves and mountains surrounding the town to repay the Earth Lord, *Yahval Balamil*, whom they describe as a greedy Ladino in control of rain and all the products of the earth (Vogt 1969:457, 1976:17). The Yucatec Maya (Redfield and Villa Rojas 1934:205) and Lacandon Maya (McGee 1990:7) believe that caves and cenotes are dwelling places for *chacs*, traditional rain deities, and the sixteenth century Yucatec sacrificed youths in cenotes to appease rain gods (Tozzer 1941:223).

Examination of the archaeobotanical specimens in conjunction with ethnographic information supports the interpretation that agricultural rites were conducted at the rural cave sites. With the exception of the maize starch grains from Actun Chechem Ha, which are probably the remnants of an ancient maize-based ceremonial beverage, there appears to be a preference for offerings of unprocessed, domesticated crops in the rural caves. Ethnographic accounts of the ritual use of unprocessed maize are often associated with agricultural rituals. For instance, Quiché priest-shamans of Momostenango, Guatemala, collect armloads of corn stalks and arrange them around shrines to ask deities for agricultural productivity (Tedlock 1982:80), and the Mam Maya of Highland Guatemala, leave dedicatory offerings of roasted ears in the local church for their patron saints (Stadelman 1940:123). Other caves in the Maya lowlands where unprocessed maize cobs have been recovered include Cueva de las Pinturas (Brady et al. 1997) and Naj Tunich (Brady 1989; Brady and Stone 1986) in Petén, Guatemala, Gordon's Cave III, located near Copán, Honduras (Brady 1995), and Mayahak Cab Pek, a rockshelter in the Maya Mountains of Belize (Goldstein and Prufer 1999).

The symbolism of unprocessed "raw" food can be found in many cultures. Raw food represents social cooperation for a community of agriculturalists (Firth 1973:255),

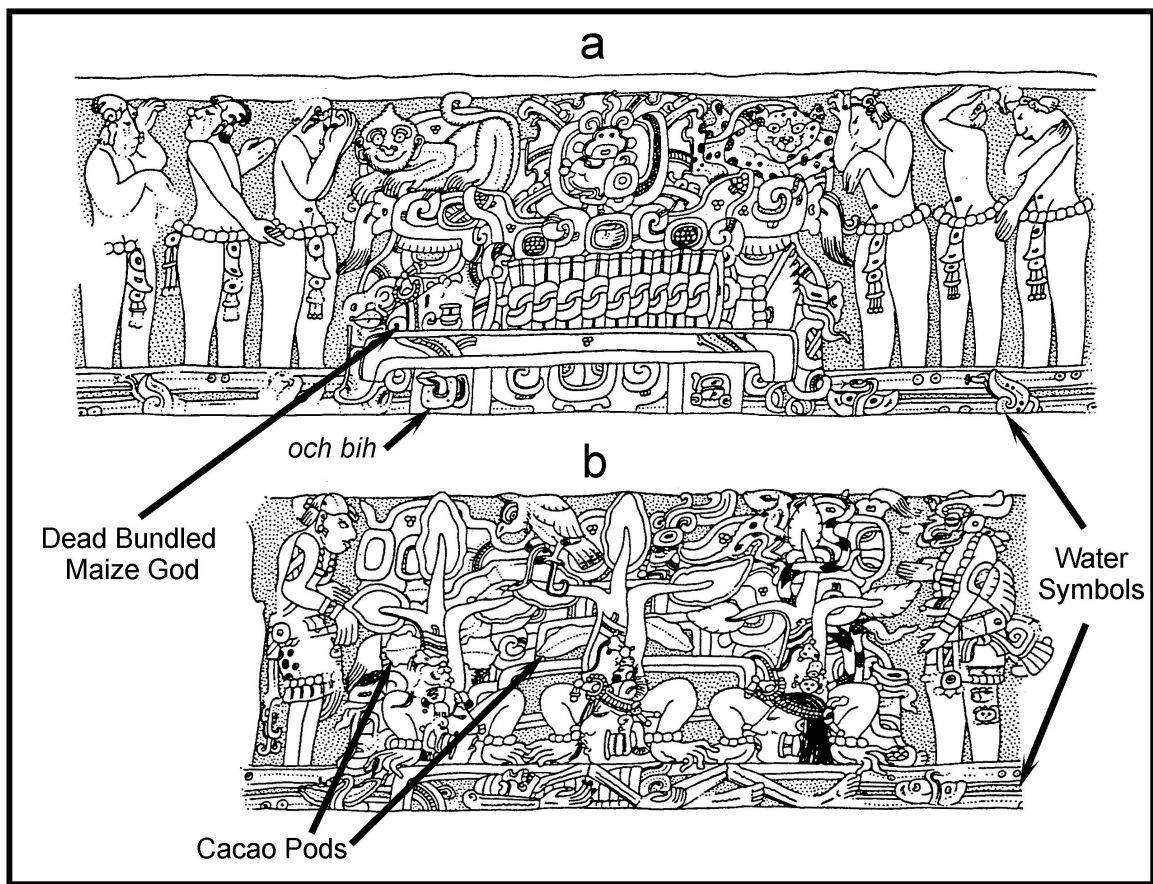


Figure 6.5a-b: Early Classic period “Death Vase” showing the maize god’s preparation for death and resurrection. The maize god can be identified by his elongated head and a “corn curl” on the back of his head (at arrow). Possible maize foliage also appears behind his ear. The central figure in 6.8b has the same markers and can be identified as the resurrected maize god. Parallels with Barton Creek Cave, Feature 23 are noted (redrawn from Taube 2002).

suggesting that the communal effort and labor expended in the agricultural cycle is metaphorically bound up in the unprocessed food. Structurally, raw or uncooked food is associated with the realm of “nature”, which is in opposition to the realm of “culture” (Levi-Strauss 1969). Because Maya earth deities are associated with nature rather than culture (e.g., Redfield and Villa Rojas 1934:111-116; Vogt 1976:32), the unprocessed condition of the agricultural products may have symbolized their relationship to earth gods.

The immaturity of maize cobs from Actun Chechem Ha might be evidence of the use of young ears of maize during first fruit rites. Modern Maya groups, such as the Lacandon and Yucatec Maya (Boremanse 1993:334; Redfield and Villa Rojas 1934:127), commonly offer young, “green” ears of maize to earth deities during first fruit ceremonies. The Lacandon believe that the earth gods must consume the first fruits of harvest before the community can eat. Some of the Early Classic period maize from Actun Chapat may have been from young ears, though it is possible that their size reflects smaller maize ears cultivated during the Early Classic period. Furthermore, the terraces at Actun Chapat that yielded the maize remains were possibly a symbolic metaphor for the numerous agricultural terraces in the surrounding Macal River Valley.

Barton Creek Cave yielded the most persuasive evidence for rituals focused toward gods associated with the forces of nature. Barton Creek Cave is a subterranean river system and has a clear relationship to water and rain, the source of agricultural fertility. Maize remains and other domesticates were found in deposits throughout the cave. Charcoal from *habín* (*Piscidia* sp.), which the modern Yucatec Maya burn during first fruit and rain ceremonies, was the second most dominant wood from the cave according to ubiquity and weight measurements. The osteological assemblage from Barton Creek Cave contains numerous primary interments of children and sub-adults. Owen (2002) has interpreted the human remains as representing sacrificial victims, demonstrating continuity with the sixteenth century Yucatec Maya practice of sacrificing youths in cenotes to appease rain gods. Feature 23 at Barton Creek Cave yielded substantial direct and indirect evidence for the offering of unprocessed foods. Maize stalks and cobs with intact husks were recovered. Seeds and fruit fragments of chile peppers and two species of squash were also found, suggesting that complete, unprocessed fruits were deposited. A fragment of cotton cloth and cotton yarns were found in association with the food remains, which may have been used to wrap the domesticates as a sacred bundle (see Taube 1985:177-178).

The spatial characteristics of food offerings from Feature 23 indicate an orientation toward the western cave wall. Although this pattern may be due to a cultural preference for placing offerings in restricted areas against cave walls, it may also reflect symbolism related to the west and the underworld. The western horizon marks the setting of the sun, where it enters the underworld through a cave (Bassie-Sweet 1996:63; Earle 1986:158; Sosa 1986:193). In the ethnohistoric Yucatec Maya text, *The Book of Chilam Balam of Chumayel*, black maize is associated with the western setting sun (Roys 1933). The Mopan Maya of southern Belize believe that black maize is sacred (Steinberg 1999:132), and the Tzotzil Maya of Chiapas, Mexico, make black tortillas from a bluish-black maize for funerary rites celebrating the deceased's passage through the underworld (Gossen 1974:39).

The iconography of an Early Classic period vessel known as the "Death Vase" has striking thematic parallels with the archaeobotanical assemblage from Feature 23 (Taube 2002:22-23) (Figure 6.5a-b), possibly indicating that the ancient Maya were attempting to re-enact mythological episodes in Barton Creek Cave. The vessel portrays the maize god in the watery underworld of a mountain, *witz*, in preparation for his journey into death and resurrection. The basal band of the vessel displays water motifs that symbolize the underworld, suggestive of the river that flows through Barton Creek Cave. One side of the vessel shows the dead, bundled maize god, similar to the possible bundled maize of Feature 23, with six maidens standing over him in mourning (Figure 6.8a). The left leg of the platform supporting the maize god contains the Classic Mayan death sign *och bih*, meaning "he enters the road" (Coe and Stone 2001:62; Taube 2002:23), reminiscent of the western path or "road" of the sun entering the underworld and the western orientation of Feature 23's bundled maize. Furthermore, the opposite side of the vessel depicts three tree motifs, two with cacao pods attached to their trunks (Figure 6.8b). As previously discussed, Feature 23 was the only sampled deposit from the cave sites that yielded cacao (*Theobroma* sp.) charcoal.

### Tree Fruits

In contrast to the rural cave sites where ceremonies associated with agricultural products were common, qualitatively different ritual practices are evident at Actun Nak Beh in the Roaring Creek Valley. A causeway connects the entrance of Actun Nak Beh to the medium-sized ceremonial center Cahal Uitz Na, the dominant organizational node for the Late Classic period inhabitants of the Roaring Creek Valley (Awe and Helmke 1998). Actun Nak Beh's association with Cahal Uitz Na allows the cave to be characterized as an "urban" cave site. Halperin (2002:125; Halperin et al. 2001) has argued that the causeway leading to Actun Nak Beh and Actun Nak Beh's main entrance were loci for public rituals. The public nature of ritual performances at Actun Nak Beh facilitated social interaction and established social inequalities (see below).

Ceremonial events that function to demonstrate social and economic differences commonly incorporate wealth items or prestige goods. For example, feasts typically involve the conspicuous consumption of massive amounts of food as well as gift giving in order to increase the prestige of feast sponsors (Dietler and Hayden 2001) and to develop a relationship of indebtedness between themselves and feast participants, or a patron-client relationship (Pohl and Pohl 1994). The development of and restricted access to prestige goods, especially those made from rare and exotic materials, was integral to the expression of power, and the demand for these items facilitated widespread political and economic spheres of interaction (Freidel 1979). Objects perceived to be valuable become a source of metaphors for evaluating the people who have access to them (Lesure 1999:24).

Traditional artifactual forms of wealth items, such as jade and exotic ceramic wares, are not abundant at Actun Nak Beh (Halperin 2002:125), but the botanical food remains from the site can be interpreted as symbols of wealth and power. Like any form of material culture, access to botanical resources and foods can be restricted and controlled by individuals and groups in dominant social, economic, and political positions. For instance, the differential distribution of pine remains from the cave sites suggests that the use of pine for cave rituals was restricted to higher status groups, such as those who used Actun Chechem Ha and Actun Nak Beh. The only plant food items recovered from Actun Nak Beh consist of nance (*Byrsonima crassifolia*) and cohune (*Attalea cohune*) fruits from a burial (Burial 2) in the cave's entrance. This burial was a secondary interment in the cave's entrance, suggesting that the individual may have been an ancestral figure of Cahal Uitz Na's ruling lineage whose remains were re-deposited at the cave as an act of veneration (Halperin 2002:107-108, see also McAnany 1995). Other artifacts associated with Burial 2 include three prismatic obsidian blade fragments, a slate pendant, and Late Classic period ceramics (Halperin 2002:52), reinforcing the individual's sacred, elite status.

Contemporary Mesoamerican groups use both nance and cohune for a number of purposes. The fruits of nance, known as *chi'* in Yucatec Mayan, are commonly sold in modern markets, and it is cultivated by many Maya groups who eat the raw fruits, make it into a fermented beverage, and use it for medicines (Atran and Ucan Ek' 1999:Table 2.2; Breedlove and Laughlin 2000:151-152; Berlin et al. 1974:289; Roys 1931:234-235, 306; Wisdom 1940:62). The sixteenth century Yucatec Maya cultivated nance trees for the edible fruits and used the bark to tan animal skins (Marcus 1982:242; Tozzer 1941:199). The leaves of cohune palms are widely used as a source of thatch, and the fruits are eaten raw and provide a useful source of cooking oil (Atran and Ucan Ek' 1999:Table 2.2; McKillop 1996:290; McSweeney 1995:165-168). Commercial trade in the "heart" or palmito of the cohune palm, composed of the tree's apical meristem and undeveloped leaves, is a lucrative business in modern-day Belize (McSweeney 1995:168-169). Cohune hearts can be

eaten raw or cooked and can be processed into wine (Balick 1990:93; McKillop 1996:291; McSweeney 1995:Table 1), a use that characterizes other neotropical palms such as coyol (*Acrocomia aculeata*) (Balick 1990; Lentz 1990:185).

The nance and cohune remains may be evidence that the rulers of Cahal Uitz Na owned orchards of economically useful trees. By restricting access to orchard trees, these trees became symbols of the dominant groups who controlled them. Among the post-Conquest Yucatec Maya, elites maintained orchards that were an inheritable source of both wealth and prestige (Tozzer 1941:64). Archaeobotanical data of possible orchard species, such as nance and coyol palm, from Cerros, a Formative period site located in northern Belize, suggest that the restricted access to orchard species began by the Late Formative period in the Maya Lowlands (Cliff and Crane 1989; see Chapter 2). As just discussed, nance, cohune, and coyol can be fermented into wine, and the consumption of such wine may have been an aspect of elite rituals and politically motivated feasts during ancient Maya society.

By offering tree fruits to ancestors, Cahal Uitz Na's ruling groups may have been making symbolic "payments" to the deified figures responsible for establishing their lineage and their sources of economic and political power. A Late Classic period example of this relationship between orchard species and royal dynasty is found in the iconography of Pakal's tomb at Palenque (Figure 6.6), located in Lowland Chiapas, Mexico, where Pakal's ancestors are depicted with economically useful fruit trees (Robertson 1983:68, Figures 181-186). Pakal's father, *Kan Bahlum Mo'*, is associated with a nance tree. The association between Pakal's ancestors and orchard species metaphorically links these trees to inheritable sources of social, political, and economic power (McAnany 1995:75; Schele and Mathews 1998:119-124). Further, in the Popol Vuh (Tedlock 1985:90), the nance was the "great tree of Seven Macaw." Seven Macaw, who attempted to establish himself as powerful by claiming he was the sun god, sat in the tree in order to eat the nance fruits (see also Thompson 1930:192).

### Cave Rituals and Social Processes

Archaeobotanical and archaeological data indicate regional differences in the utilization of caves in the Upper Belize Valley during the Classic period. Rituals at Actun Nak Beh, an urban cave, were public events that served overt social, economic, and political ends (Halperin 2002), involving the offering of tree fruits—orchard species that were symbols of wealth and royal inheritance—to possible ancestors who were buried in Actun Nak Beh's primary entrance. The caves in the rural countryside, especially Actun Chapat, Actun Chechem Ha, and Barton Creek Cave, where archaeobotanical remains of domesticated cultigens were found in abundance, were the loci for more private rites conducted to appease deities associated with the earth. Despite



Figure 6.6: Kan Bahlum Mo' with nance tree from Pakal's Sarcophagus at the Temple of Inscriptions, Palenque, Mexico (redrawn from Robertson 1983:Figure 181).

regional distinctions in cave utilization, there are salient commonalities in the botanical assemblages from all cave sites. These similarities indicate a long tradition of shared understandings surrounding the symbolism and proper ritual use of plants.

### Caves as Pilgrimage Centers

Caves in the Upper Belize Valley may have been pilgrimage centers. Pilgrimages are acts of devotional expression that involve a journey to a sacred shrine (Morinis and Crumrine 1991:2; Sallnow 1981). Turner (1969; 1979) stresses the symbolic egalitarianism of pilgrimages, considering pilgrimages as a form of *communitas* in opposition to the structure of the society undertaking a pilgrimage. Through pilgrimages societal divisions among groups of pilgrims are removed, creating an undifferentiated communion of individuals who collectively submit to the authority of the gods.

Although Turner's perspective on pilgrimages is useful in its emphasis of the collective identity that can develop through ritual, one of the crucial aspects of pilgrimages is their role in maintaining competition and promoting social differences (Sallnow 1981). Societal distinctions become established as different groups associate themselves with different sacred shrines. Participation in pilgrimages is based on networks of social relationships (Sallnow 1981:174). These networks could maintain

group solidarity and establish community boundaries if one community collectively identifies itself with the same sacred shrines or they could display intra-community discontinuity if the community suffers from factional conflict among competing groups or lineages.

Many pilgrimages in Latin American cultures are not organized by the whole community per se but are sponsored by particular groups or individuals who shoulder most of the costs for the event, gaining prestige in the process (Sallnow 1981:170). Through pilgrimages these groups and individuals attempt to gain access to sources of cosmological power that are in control of their destiny (Morinis and Crumrine 1991:14). Only those groups who can afford to sponsor pilgrimages obtain access to cosmological power. The control over such ideological power, symbolic capital (Bourdieu 1977:171-183), is translated into economic and political power.

Although some cave pilgrimages culminated in public rituals in an “urban” sphere and others in private rituals in a “rural” sphere, both types of rituals had broad social, political, and ideological implications. Actun Nak Beh’s association with Cahal Uitz Na allows the cave to be characterized as an “urban” cave site. The archaeological history of Actun Nak Beh contrasts with that of the other cave sites in this study and with many other cave sites in the Upper Belize Valley. Areas in the entrance or close to the entrance of most caves in the Upper Belize Valley were used during earlier time periods while areas deeper in the caves were used during later time periods, particularly during the Late Classic period and Terminal Classic period. Actun Nak Beh’s interior was used primarily during the Early Classic period, perhaps earlier, whereas the entrance area was used during the Late Classic period, revealing a shift from private to public rituals at the site (Hlperin 2005).

The shift from private to public rituals at Actun Nak Beh is likely the result of the high degree of political instability and competition in the Upper Belize Valley during the Late Classic period. Public spheres are social realms where collective social opinions can be formed (Habermas 1991), and where the Maya maintained shared connections with the supernatural (Farriss 1984:290). An increase in public cave rituals at Actun Nak Beh during the Late Classic period reflects the need to communicate the power of Cahal Uitz Na’s dominant groups on a wide scale in order to continually legitimize their positions of power and the need to maintain the collective support of Cahal Uitz Na’s subordinate client population.

Control over Actun Nak Beh provided Cahal Uitz Na’s ruling groups with access to sources of cosmological power and identified Cahal Uitz Na’s ruling lineage with the forces of creation and life that cave’s contain. The public rituals involved the burial of possible ancestral figures associated with Cahal Uitz Na’s ruling lineage, as evidenced by secondary interments, and the offering of fruits of nance and cohune, which may have symbolized wealth and royal inheritance. Although these rituals did

not necessarily involve the offering of domesticated crops, as at the rural cave sites, Cahal Uitz Na’s rulers nevertheless sought to identify themselves and their ancestral lineage with the power of the earth and with agricultural productivity through public cave rites.

By establishing affinities with sources of cosmological power, Cahal Uitz Na’s dominant groups were transformed into something qualitatively different than the rest of the population (Helms 1998:5; Kertzer 1988:24). They were perceived as sacred and as appropriate intermediaries to the gods by subordinate client populations. This phenomenon still characterizes Maya ritual today. Modern Yucatec Maya believe that “that which is set apart” is equated with “that which is holy; that which is effective in dealing with the gods” (Redfield and Villa Rojas 1934:131).

In contrast to Actun Nak Beh, caves not associated with ceremonial centers in the Upper Belize Valley, here called rural caves, were loci for more private events that involved the offering of domesticated cultigens to gods associated with the earth. The social implications of rituals in the private recesses of the rural cave sites are more problematic because it is difficult to associate the groups who used the rural caves with any particular Upper Belize Valley polity or with any particular segment of society. Yet, these caves can still be viewed as pilgrimage centers. Below, I discuss possible explanations for the different characteristics of rural caves.

Lower status groups or farmers may have used rural cave sites. Brady and Stone (1986:20) have argued that most caves in the Maya Lowlands were used predominantly by commoners, whereas rituals conducted by elites and rulers were mainly at urban ceremonial centers. Farmers, as basic producers of staple subsistence crops, were intimately dependent on agricultural practices for their survival and, consequently, had a vested interest in ceremonial practices that assured a successful harvest. Thus, rituals conducted at rural caves were not focused on the establishment of social power, as with high status public rites. Instead, rural cave rituals were private events that involved offerings of food “payments” to compensate earth deities for the use of their domain, thereby securing a productive harvest and maintaining a successful way of life.

This explanation stresses that wide ranging differences in how the ancient Maya perceived, shared, and participated in cosmology existed. Many scholars have argued that ancient Maya cosmology was not a single monolithic tradition. Rather, it was a pluralistic system that was experienced differently among separate sectors of Maya society (Gossen and Leventhal 1993). Thompson (1970:209-233), for example, argued that the ancient Maya elites developed an over-arching cult that synthesized a diversity of cosmological beliefs into the worship of the god *Itzamna*, one of the ancient Maya creator gods. Maya commoners, Thompson argued, did not participate in the *Itzamna* cult but maintained

traditions involving the worship of a pantheon of deities associated with the earth, the source of their survival.

The ideological dichotomy between elites and commoners is similar to what Redfield (1941, 1960) has termed Great and Little Traditions. Great Traditions consist of the dominant, state ideology, whereas Little Traditions are composed of the localized folk variations of the dominant ideology. Great Traditions are characterized by public rituals in urban spheres. The public nature of Great Traditions promulgates a collective cosmological identity that legitimizes the dominant ideology, similar to rituals at Actun Nak Beh. Great Traditions serve the agendas of dominant groups and, thus, often change rapidly or are short-lived when the dominant ideology is redefined, as when the Maya were conquered by the Spanish (Farriss 1984:289). Little Traditions exist in the outlying, rural communities and in the private, domestic sphere. The private nature of Little Traditions allowed them to be maintained for longer periods of time.

Although Great and Little Traditions probably existed in ancient Maya society to some degree (Borhegyi 1956; Gossen and Leventhal 1993), this dichotomy creates a simplified picture of ancient cave rituals and social processes in the Upper Belize Valley. Furthermore, one could even characterize the secondary peripheral centers in the Upper Belize Valley, such as Cahal Uitz Na, as localized manifestations (Little Traditions) of the dominant ideology (Great Traditions) of major core centers, such as Naranjo. Caves, as pilgrimage centers, were the stage for rituals that served political goals. Groups attempting to establish themselves as politically dominant competed for access to sources of ideological power by sponsoring costly pilgrimages to caves thereby associating themselves with the interrelated symbols of creation and fertility. This political dynamic of cave rituals was not limited to the public urban sphere. Private rituals at rural cave sites may have been conducted by ruling groups to incorporate peripheral shrines with the center or by politically competitive non-ruling factions for similar purposes.

Not all the rural cave sites appear to have been used exclusively by commoners. Actun Chechem Ha, a rural cave site that yielded the archaeobotanical remains of domesticates, has both exotic ceramic wares and an undecorated limestone “stela,” suggesting that the cave may have been used by groups of high status (Awe 1998:7; Ishihara 2000:48). Actun Chechem Ha also contained substantial pine charcoal, the use of which may have been restricted by socio-economically dominant groups. Actun Chapat, another rural cave site that yielded the remains of domesticates, has large-scale architecture (Awe 1998:8; Ferguson 2000, 2001), a traditional archaeological measure of administrative control and an expression of social, economic, and political power (Abrams 1994; Ashmore 1989:273; Earle 1997:155-158). Barton Creek Cave yielded the most persuasive evidence that rituals at the site were focused toward earth deities, including the widespread occurrence of maize remains

and other domesticates as well as numerous primary interments of children and sub-adults. Feature 23 at Barton Creek Cave, which contained the best preserved domesticated food remains, also yielded a fragment of cotton cloth that may have been used to wrap the food offerings as a sacred bundle. Although one textile fragment is insufficient data to determine social status, the access to cotton cloth appears to have been restricted to higher status groups from the Classic period to the Spanish Conquest (see Chapter 2). Cotton cloth was a tribute item paid to local rulers by subordinates. Rulers used the cotton cloth to wrap sacred bundles, wore elaborately decorated cotton garments during rituals commemorating their power, and built a surplus of cotton cloth that could be exchanged with other noble groups to build political and economic alliances. Lastly, Tarantula Cave has a slate stela that is similar to the slate monuments at Cahal Uitz Na (Awe et al. 1998:219). No archaeobotanical remains of domesticated cultigens were recovered from Tarantula Cave, though this fact may reflect the small-scale sampling conducted at the site.

Regional differences among the cave sites may indicate practices in which private rites at rural caves and public rites in urban settings were both aspects of the dominant ideological system in the Upper Belize Valley during the Late Classic period. Maya rituals commonly included both private and public events (LeCount 2002). Private rites, involving the offering of sacred foods to deities, were often followed by public events, feasts and festivals, that functioned in creating social networks and in establishing social, economic, and political distinctions (see also Freidel 1981). The spatial organization of many Maya centers during the Late Classic period, such as Cahal Pech (Awe et al. 1991), incorporated both private and public ritual spaces, including semi-restricted plazas and restricted plazas. The degree of restriction was directly related to the level of exclusivity of the activities undertaken in the plazas.

Ruling groups, as mediators between the gods and the majority of the population, may have conducted private rites to earth deities believed to reside in rural caves in order to integrate geographically peripheral shrines with the ceremonial center through ritual pilgrimages, reflecting cosmological perceptions of a dual landscape. The modern Maya maintain this practice. Contemporary Maya cosmology emphasizes structural contrasts between the village or town, the “domesticated” realm of humans and culture, and the surrounding forests, the wild, “undomesticated” realm of nature that is inhabited by spirits and deities (Alcorn 1984:86; Redfield and Villa Rojas 1934:107, 111-116; Vogt 1976:32). Tzotzil Maya year renewal rituals involve a pilgrimage by the shamans of Zinacantan to mountain and cave shrines surrounding the town and to the churches of the town center (Vogt 1976:179). The pilgrimages symbolically tie the center with the sacred features of the periphery. Cyclical renewal rituals, particularly *katun* ceremonies, have been offered as a function of cave rites in ancient Maya society, possibly involving changes in political office (Bassie-



Sweet 1991, 1996; Pohl 1983; Pohl and Pohl 1983; Stone 1989). Bassie-Sweet (1991, 1996) has argued that sacred caves inhabited by earth deities marked the midpoints of the northern, southern, eastern, and western horizons and the center of the ancient Maya quadrilateral universe. Rituals at the midpoint caves during periods of transition, such as *katun* ceremonies, maintained the continuation of life, established the boundaries of the universe, and sanctified the urban city as the center of the cosmos.

Private areas at rural cave sites may have been the stage for rituals conducted by politically competitive non-ruling groups or factions. Although ritual often serves to maintain the authority of dominant groups, it also provides a basis for resistance (Kertzer 1988:168). These groups may have competed with dominant ruling lineages by sponsoring pilgrimages to caves in the rural countryside, accessing symbolic connections to agricultural fertility by offering food “payments” to earth deities and possibly by replicating aspects of public rites on a private scale.

The presence of stelae at Actun Chechem Ha and Tarantula Cave may be evidence of this process. The archaeological remains from Actun Chechem Ha indicate that the cave was utilized by a high status, non-ruling group (Ishihara 2000:48). Polychrome ceramics, a traditional measure of high status, were recovered but not in abundance, and other “elite” markers, such as jade, obsidian mirrors, and stone eccentrics, were not found. Furthermore, Actun Chechem Ha’s stela is small and plain and can be characterized as “crude” when compared to elaborate stelae at large ceremonial centers (Figure 4.17). Tarantula Cave, near a number of high status plazuela groups in the Roaring Creek Valley, also has a stela. The stela at Tarantula Cave, like the stelae at Cahal Uitz Na, is made of slate, suggesting groups using Tarantula Cave were attempting to copy the rituals that occurred at Cahal Uitz Na. It is significant that the stelae at both caves were erected in open, non-restricted chambers. Thus, the ritual space enclosing the stelae could accommodate a large gathering of individuals similar to the public rituals at Actun Nak Beh and at the open plazas of ceremonial centers, though to a substantially lesser degree. The erection of stelae in caves, like the erection of stelae at ceremonial centers, may have established the political power of local, non-ruling lineage heads who sponsored the pilgrimages and possibly commemorated rites of passage, such as *katun* endings, that occurred under the auspices of such individuals.

Although rituals in the stelae chambers at Actun Chechem Ha and Tarantula Cave are somewhat “public,” they nevertheless occurred in the private recesses of the caves’ interiors at a time when public rites were conducted at Actun Nak Beh’s entrance. The power that stems from ritual is not limited to the public realm. Private spheres are spaces where the subordinate and oppressed can become empowered. Scott (1990) developed the terms “public transcript” and “hidden transcript” to describe the dynamic dialogue between the dominant and the weak.

Public transcripts, such as the rituals at Actun Nak Beh’s entrance, involve open interactions between the powerful and the powerless in which subordinate groups accept social inequities. Hidden transcripts involve a critique of power relations that takes place in a private sphere, out-of-sight from dominant groups.

The role of the private realm in combating ideological dominance maintained in the public realm is well attested in Mesoamerican cultures. Mesoamerican cultures are publicly patriarchal. In the private domestic sphere, however, women exercise control and dominance over the economic and kin relationships of the household (Chiñas 1992; Gossen and Leventhal 1993). Tzotzil Maya men, for example, refer to their wives as *yahval hna*, “the owner of my house” (Gossen and Leventhal 1993:196). The Great and Little Traditions discussed above are separated into public and private settings. Following the Conquest, the Spaniards sought to redefine the dominant ideology of the Maya Great Tradition toward their own political agendas (Farriss 1984). The private nature of the Little Tradition allowed its traditions to persevere despite changes to the dominant political and ideological order; “this humble domain of belief was no more affected by foreign conquest or changing elite fashions than the way of life with which it enmeshed.” (Farriss 1984:288).

Ethnohistoric documents have recorded the role of private rituals in rural caves as arenas supporting the political and ideological competition of subordinate groups. In 1562, Bishop Diego de Landa discovered that many Yucatec Maya who had previously converted to Catholicism were participating in cave rituals involving the sacrifice of animals, the burning of incense, and the worship of sacred idols (Tozzer 1941:76). These activities were not simply a continuation of previous cave rites but were part of a revitalization movement of traditional religious practices used to resist the ideological, political, and economic hegemony of the colonial period Spanish regime.

Archaeological data from the Upper Belize Valley and other nearby regions support the politically competitive role of cave rituals (see Chapter 4). The presence of numerous molded-carved vases, associated with a secondary elite, in Upper Belize Valley caves during the Terminal Classic period suggests that non-ruling elites began conducting cave rituals, previously restricted to ruling groups, in order to establish access to ideological and political power (Helmke 1999). Naj Tunich, located southwest of the Upper Belize Valley in Guatemala, is considered one of the few rural caves with clear evidence of elite use (Brady and Stone 1986), including complex iconography and hieroglyphic texts that discuss regional politics on its walls (Stone 1995). Epigraphic decipherments indicate that the cave played a role in the factional politics of the region (Colas 1998). Drawing 82, for example, documents the invasion of Caracol, a powerful regional state during the Late Classic period, by Ixkun, a smaller polity.

## Commonalities in Ancient Maya Cave Rituals

Despite regional differences between rural and urban and public and private, there were pervasive similarities in ancient Maya cave rituals. The most significant commonality is thematic rather than archaeological. Caves, both rural and urban, were liminal realms, representing a transitional sphere between earth and underworld, night and day, and life and death. Caves were associated with the first maize used to create humans, and caves were believed to be dwelling places of deities who controlled the forces of nature such as rain, wind, and agricultural fertility. Although groups attempting to maintain or establish political power competed for access to this cosmological power by sponsoring costly pilgrimages to caves, the symbolic features of caves were likely experienced by all levels of society, from ruling elites to non-ruling commoners, otherwise cave rituals would have had no social impact. Whether groups were maintaining or resisting dominance through ritual, all were manipulating shared cave symbolism toward their own ends with the same outcome, the replication of social inequalities already inherent in the structure of ancient Maya society (i.e., Giddens 1979).

The archaeobotanical assemblage suggests similarities in cave rituals in the Upper Belize Valley. Burned wood, especially pine, was recovered from all cave sites. The burning of pine accompanied cave rituals from the Early Classic period, perhaps earlier, to the Late Classic period. The ancient burning of pine during rituals was analogous to the modern burning of candles, which most modern Maya believe are symbolic food offerings. The ubiquitous occurrence of pine remains suggests a widespread, common understanding of the symbolism surrounding pine burning throughout the Classic period in the Upper Belize Valley.

Evidence of genuine food offerings was recovered from Actun Nak Beh, Barton Creek Cave, Actun Chapat, and Actun Chechem Ha. The fact that Actun Halal and Tarantula Cave did not yield food offerings may be due to poor preservation or insufficient sampling. Carbonized fruit remains of hog plum (*Spondias* sp.) and passion fruit (*Passiflora* sp.) were found at Twin Caves 2, but it was impossible to determine if they were culturally or naturally deposited.

Differences between the types of food remains, domesticated species versus orchard species, contributed to the proposed distinction between the public, urban rituals at Actun Nak Beh and the private, rural rituals at Actun Chechem Ha, Barton Creek Cave, and Actun Chapat. Despite the difference in type, as food offerings they served similar ritual functions. The domesticated cultigens belonged to gods who controlled the forces of nature. They were offered to these earth deities as symbolic payments to compensate for the use of their domain. The fruits of nance and cohune from Actun Nak Beh were recovered from a secondary burial located in the cave's entrance. The individual interred may have

been an ancestral figure associated with the ruling lineage at Cahal Uitz Na. Although the fruits possibly symbolized the wealth and power of the lineage, they were ultimately offerings to the deified ancestors who were the source of the ruling lineage's continued wealth and power.

The symbolic association between burning and food offerings is common for almost all types of Maya rites. In order for the gods to consume an offering it must be converted to its fragrant, spiritual essence through fire. The aromatic smoke produced by burning offerings, such as pine torches and copal incense, represented the *ch'u'lel*, "breath-soul," that was consumed by the deities and ancestors (Houston and Taube 2000:267; Taube 2002:6). This belief is not restricted to the burning of incense and woods, such as pine torches, but characterizes the offering of edible foods as well. With the exception of maize starch grains and immature cobs from Actun Chechem Ha, all botanical food remains from the cave sites are carbonized. The burned condition of the food remains indicates that ancient Maya ritual practitioners were attempting to release the inner soul of the food with fire.

The commonalities in archaeobotanical remains from the cave sites in the Upper Belize Valley and the recovery of similar plant remains, such as pine charcoal, copal incense, and food offerings, from ceremonial contexts at residential sites suggests that multiple levels of ancient Maya society may have used a formulaic assemblage of plant paraphernalia for rituals, regardless of the ultimate function of the rite. Commonalities in ritual paraphernalia are abundant in the ethnographic literature (i.e., McGee 1990; Oakes 1951; Tedlock 1982; Wisdom 1940; Vogt 1976), and anthropologists have long recognized the high degree of similarity and overlap in the material components of Maya ceremonies (Love and Peraza Castillo 1984:282; Redfield and Villa Rojas 1934:128). The primary distinctions between different kinds of rituals are the prayers, songs, and the ceremonial habits or preferences of individual ritual practitioners (Alcorn 1984:199; Love and Peraza Castillo 1984:282). Unfortunately, archaeological remains alone cannot provide information on the oral traditions surrounding the cave rituals.

The similarities in the archaeobotanical assemblages from the cave sites in the Upper Belize Valley are both limiting and revealing. The previous section discussed explanations of regional differences in the utilization of caves. Although the archaeobotanical data contribute to these interpretations, they cannot be used to determine such distinctions alone. The most informative data on regional variations in cave rituals in the Upper Belize Valley come from other archaeological sources, particularly the geographical location of the cave sites in relation to ceremonial centers, archaeological indicators of status, such as stelae and exotic ceramic wares, and temporal differences in the spatial use of caves, namely public versus private. It is possible that future paleoethnobotanical research in the caves of the Upper

Belize Valley may further contribute to understanding the nature of regional differences in cave rituals.

Despite the limitations of using the present archaeobotanical data to infer differences in cave rituals, the similarities illuminate the nature of ancient Maya ritual. Widespread commonalities in archaeobotanical assemblages from ceremonial contexts at caves and surface sites reveal a tradition of shared understandings on the symbolism surrounding plants and of collective knowledge of proper ritual behavior. Shared symbols are a significant means for establishing a collective identity that cross-cuts social, economic, and political divisions. The same basic symbolic components of ritual experience are manipulated regardless if a group's goal is to oppress or resist, and the use of shared symbols is necessary to validate the cultural meaning of ritual performances. Thus, symbolically significant plants and other material items were active participants in ancient Maya rituals that served to legitimize and empower all ceremonial activity.

## CHAPTER 7

### CONCLUSIONS

Plants used during Maya rituals from antiquity to the present day were specifically selected for the symbolic and mythological elements attributed to them. Plants, as symbols in Maya cosmology, were integral components of Maya ceremonial activities that served to reinforce the validity of ritual experience. Yet, the ritual use of plants by the ancient Maya has largely been ignored by archaeobotanists focused on reconstructing prehistoric economies and environment and even by archaeologists interested in documenting pre-Columbian Maya ritual practices.

This thesis hypothesized that the utilization of caves during Maya prehistory was almost exclusively ceremonial (Awe 1998; Bassie-Sweet 1991, 1996; Brady 1989; Brady and Stone 1986; Pohl and Pohl 1983; Stone 1995). Thus, Maya cave archaeology offers a unique opportunity to reconstruct ancient Maya ritual practices. Caves represented liminal realms in Maya cosmology, a threshold between two structured states: earth and underworld, night and day, and life and death. Caves were associated with concepts related to life. The first maize, from which humans were created, originated in a cave, and caves were believed to be the dwelling places for earth deities that controlled the forces of nature responsible for maintaining the continuation of life.

The powerful elements associated with caves made caves effective symbolic capital that was ritually appropriated by groups seeking to maintain or establish political and economic authority. This aspect of cave utilization is significant in view of the decentralized and politically competitive organization of Late Classic period political entities of the Upper Belize Valley (Ball and Taschek 1991; Taschek and Ball 1999). The Late Classic period of the southern Maya Lowlands (ca. A.D. 600-900) was a time of conflict and both natural and human-induced ecological stress. These combined factors promoted instability among political centers and factions. Ritual served as one of the primary means by which competing groups vied with one another for power and prestige. Caves and rockshelters in the Upper Belize Valley were likely the loci for pilgrimages sponsored by groups seeking to obtain access to the cosmological power that caves held. Securing restricted access to such sources of ideological power formed the basis for the establishment and maintenance of political and economic power (Earle 1997; Giddens 1979; Helms 1998; Kertzer 1988).

The presence of a large assemblage of plant and organic materials from seven cave sites in Upper Belize Valley of western Belize, Actun Nak Beh, Twin Caves 2, Tarantula Cave, Barton Creek Cave, Actun Chechem Ha, Actun Chapat, and Actun Halal, reveals that plants played a central role in ancient Maya cave rituals. Botanical remains include numerous species of wood charcoal, such as pine (*Pinus* sp.), habín (*Piscidia* sp.), copal tree

(*Protium* sp.), cacao (*Theobroma* sp.), balche' (*Lonchocarpus* sp.), and a wide diversity of other wood taxa. Botanical food remains include domesticates, such as maize (*Zea mays*), beans (*Phaseolus vulgaris*), squash (*Cucurbita pepo* and *Cucurbita moschata*), and chile peppers (*Capsicum annuum*), and the fruits of edible trees, particularly nance (*Byrsonima crassifolia*) and cohune palm (*Attalea cohune*). All cave sites yielded botanical remains from Late Classic period (ca. A.D. 600-900) contexts. Additionally, some plant remains from Actun Nak Beh and Actun Chapat were from deposits dated to the Early Classic period (A.D. 300-600), perhaps earlier. Thus, the overall botanical assemblage has substantial chronological depth.

A regional evaluation of the archaeobotanical assemblage uncovered significant patterns that would not have been uncovered if the scale of this study had been based solely on data from a single site. Regional differences in the types of botanical food items from the caves were examined in light of distinctions between the cave sites apparent from other sources of archaeological data. Actun Nak Beh's direct association with Cahal Uitz Na via a causeway allows the cave to be characterized as an "urban" cave site. The rituals conducted at Actun Nak Beh were public events most likely sponsored by Cahal Uitz Na's dominant political group (Halperin 2002). Public rites at Actun Nak Beh served to legitimize the authority of Cahal Uitz Na's ruling group by associating its lineage with caves and by maintaining restricted access to cosmological power. The food remains from Actun Nak Beh consist of the fruits of nance (*Byrsonima crassifolia*) and cohune palm (*Attalea cohune*) from a secondary burial, possibly an ancestral figure in Cahal Uitz Na's lineage, in the cave's entrance. These tree fruits have been interpreted as orchard species that symbolized the wealth and power of Cahal Uitz Na's ruling lineage.

The rural cave sites contrast with the archaeological characteristics of Actun Nak Beh. These cave sites are not located in close proximity to a ceremonial center. Rituals conducted at rural cave sites are interpreted as private events in the caves' interiors. Offerings of numerous, apparently unprocessed, domesticated cultigens suggest that these rites were centered on symbolic payments to earth deities believed to reside in caves in order to maintain agricultural productivity. This observation is particularly relevant at Barton Creek Cave. Barton Creek Cave is a subterranean river system, suggesting an association with water and rain, the source of agricultural fertility. Osteological remains from the cave have been interpreted as representing sacrificial victims offered to earth deities (Owen 2002). Feature 23 at Barton Creek Cave yielded food remains that were remarkably well-preserved due to rocks that had spalled off the cave wall and covered the feature, such as maize (*Zea mays*), beans (*Phaseolus vulgaris*), squash (*Cucurbita pepo* and *C. moschata*), and chile peppers (*Capsicum annuum*), as well as cotton textiles. The association of the cotton cloth with the food items suggests that the food may have been an offering wrapped as a sacred bundle.

The content of Feature 23's botanical remains and the spatial characteristics of their placement offer insight into more specific aspects of Maya ritual activities. The western orientation of the botanical offerings, particularly maize, may symbolize the sun's western descent into the underworld. The presence of bundled maize facing west is reminiscent of themes in Classic period artwork, such as the Early Classic period "Death Vase," which shows the bundled maize god in preparation for death and resurrection in the underworld. The parallel with this Classic period mythological event suggests that Maya ritual practitioners at Barton Creek Cave were attempting to re-create the death and resurrection of the maize god symbolically. Although archaeobotanical deposits elsewhere at Barton Creek Cave and at the remaining cave sites are not as extensive as those from Feature 23, it is possible that the re-creation of myth was a central theme surrounding most cave rituals.

Although it is unclear who used the caves in the surrounding rural countryside, rituals at rural cave sites likely served political goals. Pilgrimages to caves, whether urban or rural, were undertaken by groups seeking to establish or maintain access to cosmological power, which could be translated into political and economic power. Dominant political groups at urban centers may have sponsored pilgrimages to rural caves in order to incorporate peripheral shrines with the center, thereby sanctifying the city as the center of the universe. Conversely, non-ruling, subordinate groups may have utilized private areas in caves to establish access to ideological power in order to compete with politically dominant ruling groups.

Despite the regional differences in the utilization of caves in the Upper Belize Valley, the botanical assemblages indicate that there were substantial commonalities in ritual activities among the cave sites. The burning of woods, particularly pine, and incense and the offering of foods, whether domesticated cultigens or tree fruits, were a central aspect of Maya cave rituals. Burning these offerings transformed them into their spiritual essence for the gods to consume. Furthermore, similar plant remains have been recovered from ceremonial contexts at surface sites and caves throughout the Maya Lowlands, such as Naj Tunich, Guatemala (Brady 1989; Brady and Stone 1986), Actun Polbilche, Belize (Pendergast 1974), Caracol, Belize (Chase and Chase 1998:317), Pook's Hill, Belize (Morehart 2002a), La Milpa, Belize (Hammond et al. 2000:43), and Copán, Honduras (Lentz 1991). These commonalities suggest that the Maya may have maintained a formulaic assemblage of plants to be used for ceremonies, indicating widespread and long-term traditions in ritual behavior. Such shared symbols crosscut social, economic, and political divisions and were integral to the legitimization of ritual activities.

This study has demonstrated that plant remains can be used to understand prehistoric Maya ritual. The recovery, analysis, and interpretation of botanical materials recovered from ceremonial contexts at caves have

provided unique insights into ancient Maya ritual activities that greatly enhances information from other sources of archaeological data. Furthermore, caves offer an avenue of research for paleoethnobotanists seeking to recover well-preserved plant and organic materials that are rarely preserved at surface sites. Additional archaeobotanical research at cave sites in the Maya region is needed in order to take advantage of caves' remarkable preservation and to enrich our current understandings of ancient Maya interactions with the plant world.

**APPENDIX A: ARCHAEOBOTANICAL DATA**

|                      |                        |                            |             |               |          |                 |
|----------------------|------------------------|----------------------------|-------------|---------------|----------|-----------------|
| <b>Actun Halal</b>   |                        |                            |             |               |          |                 |
| <b>ID Number</b>     | <b>Provenience</b>     | <b>Plant</b>               | <b>Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b> |
| 10001-001            | E2, U1, L 7            | Hardwood                   | Charcoal    | 0.09          | -        |                 |
| 10002-001            | E1, U2, L2             | cf. <i>Licania arborea</i> | Charcoal    | 0.2           | -        |                 |
| 10002-002            | E1, U2, L2             | <i>Pinus</i> sp.           | Charcoal    | 0.2           | -        |                 |
| 10002-003            | E1, U2, L2             | Verbenaceae                | Endocarp    | 0.32          | -        |                 |
| 10003-001            | E1, U3, L1             | <i>Pinus</i> sp.           | Charcoal    | 0.07          | -        |                 |
| 10004-001            | E1, U3, L2             | <i>Pinus</i> sp.           | Charcoal    | 1.51          | -        |                 |
| 10004-002            | E1, U3, L2             | Leguminosae                | Charcoal    | 0.04          | -        |                 |
| 10004-003            | E1, U3, L2             | Dicot                      | Charcoal    | 6.03          | -        |                 |
| 10004-004            | E1, U3, L2             | Lauraceae                  | Charcoal    | 0.13          | -        |                 |
| 10004-005            | E1, U3, L2             | <i>Ficus</i> sp.           | Charcoal    | 0.05          | -        |                 |
| 10004-006            | E1, U3, L2             | Verbenaceae                | Endocarp    | 1.6           | -        |                 |
| 10004-007            | E1, U3, L2             | Hardwood                   | Charcoal    | 0.14          | -        |                 |
| 10005-001            | E1, U3, L2, F1         | Dicot                      | Charcoal    | 3.31          | -        |                 |
| 10006-001            | E1, U3, L3             | <i>Pinus</i> sp.           | Charcoal    | 1.43          | -        |                 |
| 10006-002            | E1, U3, L3             | Verbenaceae                | Fruit Pit   | 0.67          | 1        |                 |
| 10006-003            | E1, U3, L3             | Araliaceae                 | Charcoal    | 0.81          | -        |                 |
| 10006-004            | E1, U3, L3             | Dicot                      | Charcoal    | 0.1           | -        |                 |
| 10006-005            | E1, U3, L3             | Rubiaceae                  | Charcoal    | 0.1           | -        |                 |
| 10006-006            | E1, U3, L3             | Leguminosae                | Charcoal    | 0.21          | -        |                 |
| 10006-007            | E1, U3, L3             | <i>Aspidosperma</i> sp.    | Charcoal    | 0.29          | -        |                 |
| 10007-001            | E2, U4, L6             | Verbenaceae                | Endocarp    | 1.08          | -        |                 |
| 10007-002            | E2, U4, L6             | Dicot                      | Root        | 0.3           | -        |                 |
| 10007-003            | E2, U4, L6             | Dicot                      | Rind        | 0.1           | -        |                 |
| <b>Actun Nak Beh</b> |                        |                            |             |               |          |                 |
| <b>ID Number</b>     | <b>Provenience</b>     | <b>Plant</b>               | <b>Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b> |
| 10008-001            | E1, U1, L2             | Meliaceae                  | Charcoal    | 0.73          | -        | Disturbed       |
| 10009-001            | E1, U1, L3             | Meliaceae                  | Charcoal    | 0.18          | -        | Disturbed       |
| 10010-001            | E1, U1, L5             | <i>Pinus</i> sp.           | Charcoal    | 3.95          | -        |                 |
| 10011-001            | E1, U1, L5             | <i>Andira inermis</i>      | Charcoal    | 1.25          | -        |                 |
| 10011-002            | E1, U1, L5             | <i>Attalea cohune</i>      | Endocarp    | 0.25          | -        |                 |
| 10012-001            | E1, U1, L6             | <i>Pinus</i> sp.           | Charcoal    | 0.18          | -        |                 |
| 10012-002            | E1, U1, L6             | Hardwood                   | Charcoal    | 0.25          | -        |                 |
| 10012-003            | E1, U1, L6             | Dicot                      | Charcoal    | 0.05          | -        |                 |
| 10012-004            | E1, U1, L6             | Dicot                      | Charcoal    | 0.25          | -        |                 |
| 10013-001            | E1, U1, L6             | <i>Pinus</i> sp.           | Charcoal    | 0.11          | -        |                 |
| 10013-002            | E1, U1, L6             | <i>Byrsonima</i> sp.       | Charcoal    | 0.13          | -        |                 |
| 10013-003            | E1, U1, L6             | <i>Rheedia</i> sp.         | Charcoal    | 0.11          | -        |                 |
| 10014-001            | E1, U1, L7             | <i>Pinus</i> sp.           | Charcoal    | 0.32          | -        |                 |
| 10014-002            | E1, U1, L7             | Leguminosae                | Charcoal    | 0.08          | -        |                 |
| 10014-003            | E1, U1, L7             | <i>Byrsonima</i> sp.       | Charcoal    | 0.21          | -        |                 |
| 10014-004            | E1, U1, L7             | Unknown                    | Residue     | 0.54          | -        |                 |
| 10015-001            | E1, U1, L8             | <i>Pinus</i> sp.           | Charcoal    | 0.28          | -        |                 |
| 10016-001            | E1, U1ext, L6          | <i>Pinus</i> sp.           | Charcoal    | 1.2           | -        |                 |
| 10017-001            | E1, U1ext, L6          | <i>Pinus</i> sp.           | Charcoal    | 0.79          | -        |                 |
| 10018-001            | E1, U1ext, L7          | <i>Pinus</i> sp.           | Charcoal    | 2.34          | -        |                 |
| 10018-002            | E1, U1ext, L7          | <i>Byrsonima</i> sp.       | Charcoal    | 6.86          | -        |                 |
| 10019-001            | E1, U1ext, L8 (SW &SE) | <i>Pinus</i> sp.           | Charcoal    | 1.19          | -        | Burial 2        |

|              |                         |                                   |                      |      |   |                          |
|--------------|-------------------------|-----------------------------------|----------------------|------|---|--------------------------|
| 10019-002    | E1, U1ext, L8 (SW & SE) | Rosaceae                          | Fruit pit            | 0.78 | 1 | Burial 2                 |
| 10020-001    | E1, U1ext, L8           | <i>Pinus</i> sp.                  | Charcoal             | 4.79 | - |                          |
| 10020-002    | E1, U1ext, L8           | c.f. <i>Hymenaea coubaril</i>     | Charcoal             | 1.05 | - |                          |
| 10020-003    | E1, U1ext, L8           | c.f. <i>Hymenaea coubaril</i>     | Charcoal             | 0.26 | - |                          |
| 10020-004    | E1, U1ext, L8           | <i>Byrsonima crassifolia</i>      | Pit                  | 0.11 | - |                          |
| 10020-005    | E1, U1ext, L8           | c.f. <i>Hymenaea coubaril</i>     | Charcoal             | 0.21 | - |                          |
| 10020-006    | E1, U1ext, L8           | c.f. <i>Alvaradoa amorphoides</i> | Charcoal             | 0.12 | - |                          |
| 10021-001    | E1, U1ext, L8           | c.f. Euphorbiaceae                | Parenchyma           | 0.01 | - |                          |
| 10021-002    | E1, U1ext, L8           | <i>Byrsonima crassifolia</i>      | Pit                  | 0.2  | 1 | 1 complete and fragments |
| 10021-003    | E1, U1ext, L8           | Unknown                           | Residue              | 0.39 | - | Chemical                 |
| 10021-004    | E1, U1ext, L8           | <i>Pinus</i> sp.                  | Charcoal             | 6.85 | - |                          |
| 10021-005    | E1, U1ext, L8           | Moraceae                          | Charcoal             | 0.02 | - |                          |
| 10021-006    | E1, U1ext, L8           | <i>Aspidosperma</i> sp.           | Charcoal             | 0.19 | - |                          |
| 10021-007    | E1, U1ext, L8           | Hardwood                          | Charcoal             | 0.13 | - |                          |
| 10021-008    | E1, U1ext, L8           | <i>Persea</i> sp.                 | Charcoal             | 0.61 | - |                          |
| 10021-009    | E1, U1ext, L8           | <i>Cassia</i> sp.                 | Charcoal             | 0.13 | - |                          |
| 10021-010    | E1, U1ext, L8           | Dicot                             | Charcoal             | 0.88 | - |                          |
| 10021-011    | E1, U1ext, L8           | <i>Byrsonima</i> sp.              | Charcoal             | 0.84 | - |                          |
| 10022-001    | E1, U1ext, L8           | <i>Pinus</i> sp.                  | Charcoal             | 9.88 | - | Burial 3                 |
| 10022-002    | E1, U1ext, L8           | <i>Cassia</i> sp.                 | Charcoal             | 0.19 | - | Burial 3                 |
| 10022-003    | E1, U1ext, L8           | Dicot                             | Charcoal             | 0.7  | - | Burial 3                 |
| 10022-004    | E1, U1ext, L8           | <i>Byrsonima</i> sp.              | Charcoal             | 0.93 | - | Burial 3                 |
| 10022(a)-001 | E1, U1ext, L8           | <i>Pinus</i> sp.                  | Charcoal             | 2.96 | - |                          |
| 10022(a)-002 | E1, U1ext, L8           | Meliaceae                         | Charcoal             | 0.58 | - |                          |
| 10022(a)-003 | E1, U1ext, L8           | <i>Aspidosperma</i> sp.           | Charcoal             | 0.32 | - |                          |
| 10022(a)-004 | E1, U1ext, L8           | Combretaceae                      | Charcoal             | 1.23 | - |                          |
| 10023-001    | E1, U1ext, L9 (NW & NE) | <i>Pinus</i> sp.                  | Charcoal             | 5.22 | - | Burial 3                 |
| 10023-002    | E1, U1ext, L9 (NW & NE) | <i>Andira inermis</i>             | Charcoal             | -    | - | Burial 3                 |
| 10024-001    | E1, U1ext, L9 (NW & NE) | Unknown (and <i>Pinus</i> sp.)    | Residue and Charcoal | 0.08 | - | Burial 3                 |
| 10024-002    | E1, U1ext, L9 (NW & NE) | <i>Cassia</i> sp.                 | Charcoal             | 0.14 | - | Burial 3                 |
| 10024-003    | E1, U1ext, L9 (NW & NE) | <i>Pinus</i> sp.                  | Charcoal             | 1.75 | - | Burial 3                 |
| 10024-004    | E1, U1ext, L9 (NW & NE) | Unknown                           | Residue              | 0.75 | - | Burial 3                 |
| 10025-001    | E1, U2, L2 (SW & SE)    | <i>Attalea cohune</i>             | Endocarp             | 2.92 | - | Disturbed                |
| 10026-001    | E1, U2, L2              | <i>Schizolobium parahyba</i>      | Charcoal             | 2.67 | - | Disturbed                |
| 10027-001    | E1, U2, L3              | <i>Pinus</i> sp.                  | Charcoal             | 0.9  | - | Disturbed                |
| 10028-001    | E1, U2, L4              | Dicot                             | Charcoal             | 2.52 | - | Above floor?             |
| 10029-001    | E1, U2, L4              | <i>Pinus</i> sp.                  | Charcoal             | 0.54 | - |                          |
| 10030-001    | E1, U2, L5              | <i>Pinus</i> sp.                  | Charcoal             | 0.28 | - |                          |
| 10030-002    | E1, U2, L5              | Combretaceae                      | Charcoal             | 0.02 | - |                          |
| 10030-003    | E1, U2, L5              | Dicot                             | Charcoal             | 0.08 | - |                          |
| 10031-001    | C1, U4, L1              | <i>Pinus</i> sp.                  | Charcoal             | 0.75 | - |                          |
| 10032-001    | C1, U4, L2              | <i>Pinus</i> sp.                  | Charcoal             | 1.4  | - |                          |
| 10033-001    | C1, U4, L3              | <i>Pinus</i> sp.                  | Charcoal             | 0.8  | - |                          |
| 10034-004    | C5, U7, L2              | <i>Pinus</i> sp.                  | Charcoal             | 0.29 | - |                          |
| 10035-001    | C5, U7, L3              | <i>Pinus</i> sp.                  | Charcoal             | 0.54 | - |                          |
| 10036-001    | C5, U7, L6              | <i>Pinus</i> sp.                  | Charcoal             | 0.03 | - |                          |

|                          |                           |                         |             |               |          |                   |
|--------------------------|---------------------------|-------------------------|-------------|---------------|----------|-------------------|
| 10037-001                | E1, U9, L3                | <i>Pinus</i> sp.        | Charcoal    | 0.34          | -        |                   |
|                          |                           |                         |             |               |          |                   |
| <b>Barton Creek Cave</b> |                           |                         |             |               |          |                   |
| <b>ID Number</b>         | <b>Provenience</b>        | <b>Plant</b>            | <b>Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b>   |
| 10038-001                | Ledge 9, Area B, F40      | Euphorbiaceae           | Charcoal    | 54.76         | -        | Possible torch.   |
| 10039-001                | Ledge 2, Area B, U9, L2   | <i>Pinus</i> sp.        | Charcoal    | 1.11          | -        | NW corner of Unit |
| 10039-002                | Ledge 2, Area B, U9, L2   | <i>Piscidia</i> sp.     | Charcoal    | 0.32          | -        | NW corner of Unit |
| 10039-003                | Ledge 2, Area B, U9, L2   | <i>Lonchocarpus</i> sp. | Charcoal    | 0.47          | -        | NW corner of Unit |
| 10040-001                | Ledge 2, Area B, U9, L1   | <i>Allophylus</i> sp.   | Charcoal    | 0.22          | -        |                   |
| 10040-002                | Ledge 2, Area B, U9, L1   | Hardwood                | Charcoal    | 6.07          | -        |                   |
| 10040-003                | Ledge 2, Area B, U9, L1   | Hardwood                | Charcoal    | 0.15          | -        |                   |
| 10040-004                | Ledge 2, Area B, U9, L1   | Burseraceae             | Charcoal    | 0.13          | -        |                   |
| 10040-005                | Ledge 2, Area B, U9, L1   | Dicot                   | Charcoal    | 0.34          | -        |                   |
| 10040-006                | Ledge 2, Area B, U9, L1   | <i>Piscidia</i> sp.     | Charcoal    | 0.17          | -        |                   |
| 10041-001                | Ledge 2, Area B, U9, L2   | <i>Lonchocarpus</i> sp. | Charcoal    | 0.12          | -        | NE corner of Unit |
| 10041-002                | Ledge 2, Area B, U9, L2   | Hardwood                | Charcoal    | 0.9           | -        | NE corner of Unit |
| 10041-003                | Ledge 2, Area B, U9, L2   | <i>Persea</i> sp.       | Charcoal    | 1.1           | -        | NE corner of Unit |
| 10041-004                | Ledge 2, Area B, U9, L2   | <i>Piscidia</i> sp.     | Charcoal    | 0.3           | -        | NE corner of Unit |
| 10041-005                | Ledge 2, Area B, U9, L2   | Leguminosae             | Charcoal    | 0.26          | -        | NE corner of Unit |
| 10041-006                | Ledge 2, Area B, U9, L2   | Burseraceae             | Charcoal    | 0.32          | -        | NE corner of Unit |
| 10042-001                | Ledge 2                   | <i>Pinus</i> sp.        | Charcoal    | 0.48          | -        |                   |
| 10042-002                | Ledge 2                   | Burseraceae             | Charcoal    | 0.03          | -        |                   |
| 10042-003                | Ledge 2                   | <i>Lysiloma</i> sp.     | Charcoal    | 0.07          | -        |                   |
| 10042-004                | Ledge 2                   | <i>Zanthoxylum</i> sp.  | Charcoal    | 0.05          | -        |                   |
| 10042-005                | Ledge 2                   | Hardwood                | Charcoal    | 0.01          | -        |                   |
| 10043-001                | Ledge 2, Area B, U9, L2   | <i>Pinus</i> sp.        | Charcoal    | 0.49          | -        | Feature B         |
| 10043-001                | Ledge 2, Area B, U9, L2   | <i>Cedrela</i> sp.      | Charcoal    | 2.09          | -        | Feature B         |
| 10043-003                | Ledge 2, Area B, U9, L2   | <i>Ficus</i> sp.        | Charcoal    | 0.56          | -        | Feature B         |
| 10043-004                | Ledge 2, Area B, U9, L2   | Moraceae                | Charcoal    | 0.11          | -        | Feature B         |
| 10043-005                | Ledge 2, Area B, U9, L2   | Leguminosae             | Charcoal    | 0.07          | -        | Feature B         |
| 10043-006                | Ledge 2, Area B, U9, L2   | Burseraceae             | Charcoal    | 4.58          | -        | Feature B         |
| 10043-007                | Ledge 2, Area B, U9, L2   | Burseraceae             | Charcoal    | 1.26          | -        | Feature B         |
| 10043-008                | Ledge 2, Area B, U9, L2   | <i>Protium</i> sp.      | Charcoal    | 1.8           | -        | Feature B         |
| 10044-001                | Ledge 2, Area B, U9, L3/4 | <i>Pinus</i> sp.        | Charcoal    | 0.7           | -        |                   |
| 10044-002                | Ledge 2, Area B, U9, L3/4 | <i>Byrsonima</i> sp.    | Charcoal    | 0.39          | -        |                   |
| 10044-003                | Ledge 2, Area B, U9, L3/4 | Sapotaceae              | Charcoal    | 0.04          | -        |                   |
| 10044-004                | Ledge 2, Area B, U9, L3/4 | <i>Ficus</i> sp.        | Charcoal    | 0.07          | -        |                   |
| 10044-005                | Ledge 2, Area B, U9, L3/4 | Dicot                   | Charcoal    | 0.05          | -        |                   |
| 10045-001                | Ledge 2, Area B, U9, L3/4 | <i>Ficus</i> sp.        | Charcoal    | 3.41          | -        |                   |
| 10045-002                | Ledge 2, Area B, U9, L3/4 | <i>Piscidia</i> sp.     | Charcoal    | 0.33          | -        |                   |
| 10045-003                | Ledge 2, Area B, U9, L3/4 | <i>Protium</i> sp.      | Charcoal    | 0.19          | -        |                   |
| 10045-004                | Ledge 2, Area B, U9, L3/4 | Euphorbiaceae           | Charcoal    | 0.15          | -        |                   |
| 10045-005                | Ledge 2, Area B, U9, L3/4 | <i>Protium</i> sp.      | Charcoal    | 0.04          | -        |                   |
| 10045-006                | Ledge 2, Area B, U9, L3/4 | <i>Piscidia</i> sp.     | Charcoal    | 0.2           | -        |                   |



|           |                           |                         |          |      |   |                                     |
|-----------|---------------------------|-------------------------|----------|------|---|-------------------------------------|
| 10045-007 | Ledge 2, Area B, U9, L3/4 | Moraceae                | Charcoal | 0.49 | - |                                     |
| 10045-008 | Ledge 2, Area B, U9, L3/4 | <i>Pinus</i> sp.        | Charcoal | 0.2  | - |                                     |
| 10046-001 | Ledge 2, Area A, NWP      | <i>Ficus</i> sp.        | Charcoal | 0.7  | - | Surface, disturbed                  |
| 10046-002 | Ledge 2, Area A, NWP      | Hardwood                | Charcoal | 0.47 | - | Surface, disturbed                  |
| 10046-003 | Ledge 2, Area A, NWP      | <i>Pinus</i> sp.        | Charcoal | 0.12 | - | Surface, disturbed                  |
| 10046-004 | Ledge 2, Area A, NWP      | <i>Piscidia</i> sp.     | Charcoal | 0.26 | - | Surface, disturbed                  |
| 10046-005 | Ledge 2, Area A, NWP      | Hardwood                | Charcoal | 0.43 | - | Surface, disturbed                  |
| 10046-006 | Ledge 2, Area A, NWP      | Sapotaceae              | Charcoal | 0.07 | - | Surface, disturbed                  |
| 10046-007 | Ledge 2, Area A, NWP      | <i>Cedrela</i> sp.      | Charcoal | 0.07 | - | Surface, disturbed                  |
| 10046-008 | Ledge 2, Area A, NWP      | Sapotaceae              | Charcoal | 0.17 | - | Surface, disturbed                  |
| 10046-009 | Ledge 2, Area A, NWP      | Hardwood                | Charcoal | 0.27 | - | Surface, disturbed                  |
| 10046-010 | Ledge 2, Area A, NWP      | Sapotaceae              | Charcoal | 0.14 | - | Surface, disturbed                  |
| 10046-011 | Ledge 2, Area A, NWP      | <i>Cordia</i> sp.       | Charcoal | 0.07 | - | Surface, disturbed                  |
| 10046-012 | Ledge 2, Area A, NWP      | <i>Persea</i> sp.       | Charcoal | 0.08 | - | Surface, disturbed                  |
| 10046-013 | Ledge 2, Area A, NWP      | Hardwood                | Charcoal | 0.06 | - | Surface, disturbed                  |
| 10046-014 | Ledge 2, Area A, NWP      | <i>Casearia</i> sp.     | Charcoal | 0.01 | - | Surface, disturbed                  |
| 10046-015 | Ledge 2, Area A, NWP      | <i>Casearia</i> sp.     | Charcoal | 0.22 | - | Surface, disturbed                  |
| 10046-016 | Ledge 2, Area A, NWP      | Hardwood                | Charcoal | 0.05 | - | Surface, disturbed                  |
| 10046-017 | Ledge 2, Area A, NWP      | <i>Casearia</i> sp.     | Charcoal | 0.09 | - | Surface, disturbed                  |
| 10046-018 | Ledge 2, Area A, NWP      | <i>Casearia</i> sp.     | Charcoal | 0.03 | - | Surface, disturbed                  |
| 10051-001 | Ledge 2, Area A, AC116    | <i>Pinus</i> sp.        | Charcoal | 1.13 | - | Surface, disturbed                  |
| 10051-002 | Ledge 2, Area A, AC116    | <i>Ficus</i> sp.        | Charcoal | 0.08 | - | Surface, disturbed                  |
| 10051-003 | Ledge 2, Area A, AC116    | <i>Ficus</i> sp.        | Charcoal | 0.15 | - | Surface, disturbed                  |
| 10051-004 | Ledge 2, Area A           | <i>Pouteria</i> sp.     | Charcoal | 0.62 | - | Surface, disturbed                  |
| 10051-005 | Ledge 2, Area A, AC116    | Combretaceae            | Charcoal | 1.37 | - | Surface, disturbed                  |
| 10051-006 | Ledge 2, Area A, AC116    | Unknown                 | Residue  | 0.99 | - | Surface, disturbed                  |
| 10051-007 | Ledge 2, Area A, AC116    | <i>Pouteria</i> sp.     | Charcoal | 0.13 | - | Surface, disturbed                  |
| 10051-008 | Ledge 2, Area A, AC116    | Hardwood                | Charcoal | 0.07 | - | Surface, disturbed                  |
| 10051-009 | Ledge 2, Area A, AC116    | Lauraceae               | Charcoal | 0.08 | - | Surface, disturbed                  |
| 10051-010 | Ledge 2, Area A, AC116    | <i>Aspidosperma</i> sp. | Charcoal | 0.29 | - | Surface, disturbed                  |
| 10055-001 | Ledge 2, Area D, BC 25    | <i>Pinus</i> sp.        | Charcoal | 0.62 | - |                                     |
| 10055-002 | Ledge 2, Area D, BC 25    | Unknown                 | Residue  | 0.03 | - | submitted for FT-ICR MS             |
| 10055-003 | Ledge 2, Area D, BC 25    | <i>Zea mays</i>         | Kernels  | 0.04 | 3 | 3 fragments w/ carbonized endosperm |
| 10056-001 | Ledge 2, Area A           | <i>Pinus</i> sp.        | Charcoal | 0.11 | - | Surface, disturbed                  |
| 10057-001 | Ledge 2, Area A           | <i>Ficus</i> sp.        | Charcoal | 0.17 | - | Surface, disturbed                  |
| 10057-002 | Ledge 2, Area A           | Hardwood                | Charcoal | 0.21 | - | Surface, disturbed                  |
| 10058-001 | Ledge 6, BC 13            | <i>Pinus</i> sp.        | Charcoal | 0.03 | - |                                     |

|            |                          |                         |             |        |    |                              |
|------------|--------------------------|-------------------------|-------------|--------|----|------------------------------|
| 10058-002  | Ledge 6, BC 13           | <i>Vitis tiliifolia</i> | Seed        | > 0.01 | 1  |                              |
| 10058-003  | Ledge 6, BC 13           | Unknown                 | Seed        | > 0.01 | 1  |                              |
| 10058-004  | Ledge 6, BC 13           | Unknown                 | Seed        | > 0.01 | 1  | Uncarbonized                 |
| 10058-005  | Ledge 6, BC 13           | <i>Protium</i> sp.      | Charcoal    | 0.02   | -  |                              |
| 10058-006  | Ledge 6, BC 13           | Euphorbiaceae           | Charcoal    | 0.31   | -  |                              |
| 10058-007  | Ledge 6, BC 13           | Hardwood                | Charcoal    | 0.01   | -  |                              |
| 10058-008  | Ledge 6, BC 13           | Hardwood                | Charcoal    | 0.03   | -  |                              |
| 10058-009  | Ledge 6, BC 13           | Dicot                   | Charcoal    | 0.04   | -  |                              |
| 10059-001  | Ledge 8, Area C, U 8     | <i>Pinus</i> sp.        | Charcoal    | 0.1    | -  |                              |
| 10059-002  | Ledge 8, Area C, U 8     | <i>Zanthoxylum</i> sp.  | Charcoal    | 0.14   | -  |                              |
| 10060-001  | Ledge 8, Area C, U 8     | <i>Zanthoxylum</i> sp.  | Charcoal    | 0.33   | -  |                              |
| 10060-002  | Ledge 8, Area C, U 8     | Hardwood                | Charcoal    | 0.45   | -  |                              |
| 10060-003  | Ledge 8, Area C, U 8     | <i>Pouteria</i> sp.     | Charcoal    | 0.08   | -  |                              |
| 10061-001  | Ledge 8, Area C, U 8     | <i>Byrsonima</i> sp.    | Charcoal    | 1.23   | -  |                              |
| 10061-002  | Ledge 8, Area C, U 8     | <i>Byrsonima</i> sp.    | Charcoal    | 0.05   | -  |                              |
| 10062-001  | Ledge 2, Feature 23, CC3 | <i>Protium</i> sp.      | Charcoal    | 19.18  | -  | Branch                       |
| 10062-002  | Ledge 2, Feature 23, CC3 | <i>Protium</i> sp.      | Charcoal    | 7.31   | -  |                              |
| 10062-003  | Ledge 2, Feature 23, CC3 | Rubiaceae               | Charcoal    | 0.9    | -  |                              |
| 10062-004  | Ledge 2, Feature 23, CC3 | <i>Zea mays</i>         | Shoots      | 1.39   | -  | Shoot fragments              |
| 10062-005  | Ledge 2, Feature 23, CC3 | <i>Zea mays</i>         | Kernels     | 0.16   | 3  |                              |
| 10062-006  | Ledge 2, Feature 23, CC3 | <i>Zea mays</i>         | Cobs        | 10.63  | 3  | 3 cobs/ears                  |
| 10063-001  | Ledge 2, Feature 23, CC3 | <i>Zea mays</i>         | Kernels     | 0.56   | 10 | Some fragments               |
| 10063-002  | Ledge 2, Feature 23, CC3 | Hardwood                | Charcoal    | 0.37   | -  |                              |
| 10063-003  | Ledge 2, Feature 23, CC3 | Unknown                 | Fibrous ash | 0.06   | -  |                              |
| 10064-001  | Ledge 2, Feature 23, CC1 | <i>Pinus</i> sp.        | Charcoal    | 0.57   | -  |                              |
| 10064-002  | Ledge 2, Feature 23, CC1 | <i>Zanthoxylum</i> sp.  | Charcoal    | 0.19   | -  |                              |
| 10064-003  | Ledge 2, Feature 23, CC1 | <i>Zanthoxylum</i> sp.  | Charcoal    | 0.21   | -  |                              |
| 10064-004  | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>         | Cob         | 3.44   | 1  |                              |
| 10064-005  | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>         | Kernels     | 0.28   | 10 |                              |
| 10064-006  | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>         | Shoots      | 3.51   | -  | shoot fragments              |
| 10065-001  | Ledge 2, Feature 23, CC1 | <i>Pinus</i> sp.        | Charcoal    | 0.08   | -  |                              |
| 10065-002  | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>         | Shoots      | 0.14   | -  | shoot fragments              |
| 10065-003  | Ledge 2, Feature 23, CC1 | Weedy genus             | Charcoal    | 0.29   | -  | non-Zea mays shoot fragments |
| 10066-001  | Ledge 2, Feature 23, CC2 | <i>Zea mays</i>         | Shoots      | 0.29   | -  | shoot fragments              |
| 10066-002  | Ledge 2, Feature 23, CC2 | Unknown                 | Fibrous ash | 0.33   | -  |                              |
| 10066-003  | Ledge 2, Feature 23, CC2 | <i>Zea mays</i>         | Kernel      | > 0.01 | 1  | 1 fragment                   |
| 10067-001  | Ledge 2, Feature 23, CC2 | Unknown                 | Fibrous ash | 7.32   | -  | Ash sample                   |
| 10067b-001 | Ledge 2, Feature 23, CC6 | <i>Pinus</i> sp.        | Charcoal    | 0.08   | -  |                              |
| 10067b-002 | Ledge 2, Feature 23, CC6 | <i>Protium</i> sp.      | Charcoal    | 3.38   | -  |                              |
| 10067b-003 | Ledge 2, Feature 23, CC6 | <i>Theobroma</i> sp.    | Charcoal    | 0.49   | -  |                              |
| 10067b-004 | Ledge 2, Feature 23, CC6 | Weedy genus             | Charcoal    | 3.58   | -  | Non-Zea mays shoot           |

|                     |                          |                            |             |               |          |                                    |
|---------------------|--------------------------|----------------------------|-------------|---------------|----------|------------------------------------|
|                     |                          |                            |             |               |          | fragments                          |
| 10067b-005          | Ledge 2, Feature 23, CC6 | <i>Zea mays</i>            | Shoots      | 0.41          | -        | Shoot fragments                    |
| 10067b-006          | Ledge 2, Feature 23, CC6 | <i>Zea mays</i>            | Shoots      | 0.02          | -        | Shoot fragments                    |
| 10067b-007          | Ledge 2, Feature 23, CC6 | <i>Zea mays</i>            | Kernels     | 0.48          | 11       |                                    |
| 10067b-008          | Ledge 2, Feature 23, CC6 | <i>Zea mays</i>            | Cupules     | 0.02          | 2        |                                    |
| 10067b-009          | Ledge 2, Feature 23, CC6 | <i>Zea mays</i>            | Cob         | 1.81          | 3        |                                    |
| 10067b-010          | Ledge 2, Feature 23, CC6 | <i>Cucurbita</i> sp.       | Rind        | 0.23          | -        |                                    |
| 10067b-011          | Ledge 2, Feature 23, CC6 | <i>Zea mays</i>            | Cob         | 0.31          | 1        | Fused, carbonized husk and kernels |
| 10068-001           | Ledge 2, Feature 23      | <i>Pinus</i> sp.           | Charcoal    | 0.33          | -        | From screen                        |
| 10068-002           | Ledge 2, Feature 23      | <i>Zea mays</i>            | Ear frags   | 3.63          | -        | Fused, carbonized husk and kernels |
| 10068-003           | Ledge 2, Feature 23      | <i>Zea mays</i>            | Shoots      | 2.1           | -        | Shoot fragments                    |
| 10068-004           | Ledge 2, Feature 23      | <i>Zea mays</i>            | Kernels     | 1.83          | 34       |                                    |
| 10068-005           | Ledge 2, Feature 23      | <i>Theobroma</i> sp.       | Charcoal    | 0.13          | -        | Twig                               |
| 10068-006           | Ledge 2, Feature 23      | Burseraceae                | Charcoal    | 2.18          | -        |                                    |
| 10068-007           | Ledge 2, Feature 23      | Hardwood                   | Charcoal    | 4.73          | -        |                                    |
| 10068-008           | Ledge 2, Feature 23      | <i>Byrsonima</i> sp.       | Charcoal    | 2.4           | -        |                                    |
|                     |                          |                            |             |               |          |                                    |
| <b>Actun Chapat</b> |                          |                            |             |               |          |                                    |
| <b>ID Number</b>    | <b>Provenience</b>       | <b>Plant</b>               | <b>Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b>                    |
| 10069-001           | CH 3B, T 20, U 10, L 2   | <i>Pinus</i> sp.           | Charcoal    | 0.1           | -        |                                    |
| 10069-002           | CH 3B, T 20, U 10, L 2   | <i>Byrsonima</i> sp.       | Charcoal    | 0.02          | -        |                                    |
| 10069-003           | CH 3B, T 20, U 10, L 2   | Leguminosae                | Charcoal    | 0.25          | -        |                                    |
| 10069-004           | CH 3B, T 20, U 10, L 2   | <i>Cedrela</i> sp.         | Charcoal    | 0.1           | -        |                                    |
| 10070-001           | CH 3B, T 20, U 10, L 3   | Hardwood                   | Charcoal    | 0.09          | -        |                                    |
| 10070-002           | CH 3B, T 20, U 10, L 3   | Hardwood                   | Charcoal    | 0.03          | -        |                                    |
| 10070-003           | CH 3B, T 20, U 10, L 3   | Euphorbiaceae              | Charcoal    | 0.06          | -        |                                    |
| 10070-004           | CH 3B, T 20, U 10, L 3   | Leguminosae                | Charcoal    | 0.13          | -        |                                    |
| 10070-005           | CH 3B, T 20, U 10, L 3   | Euphorbiaceae              | Charcoal    | 0.08          | -        |                                    |
| 10070-006           | CH 3B, T 20, U 10, L 3   | <i>Protium</i> sp.         | Charcoal    | 0.05          | -        |                                    |
| 10070-007           | CH 3B, T 20, U 10, L 3   | <i>Quercus</i> sp.         | Charcoal    | 0.06          | -        |                                    |
| 10070-008           | CH 3B, T 20, U 10, L 3   | Hardwood                   | Charcoal    | 0.01          | -        |                                    |
| 10071-001           | CH 3B, T 20, U 10, L 4   | <i>Pinus</i> sp.           | Charcoal    | 0.02          | -        |                                    |
| 10071-002           | CH 3B, T 20, U 10, L 4   | <i>Tabebuia</i> sp.        | Charcoal    | 0.08          | -        |                                    |
| 10071-003           | CH 3B, T 20, U 10, L 4   | <i>Protium</i> sp.         | Charcoal    | 0.09          | -        |                                    |
| 10072-001           | CH 3B, T 20, U 10, L 6   | <i>Pinus</i> sp.           | Charcoal    | 0.29          | -        |                                    |
| 10072-002           | CH 3B, T 20, U 10, L 6   | <i>Allophylus</i> sp.      | Charcoal    | 0.04          | -        |                                    |
| 10072-003           | CH 3B, T 20, U 10, L 6   | Leguminosae                | Charcoal    | 0.08          | -        |                                    |
| 10072-004           | CH 3B, T 20, U 10, L 6   | Hardwood                   | Charcoal    | 0.09          | -        | Possibly Flacourtiaceae            |
| 10072-005           | CH 3B, T 20, U 10, L 6   | Dicot                      | Rind        | 0.03          | -        |                                    |
| 10072b-001          | CH 3B, T26, U 11, L 1    | <i>Allophylus</i> sp.      | Charcoal    | 0.07          | -        |                                    |
| 10072b-002          | CH 3B, T26, U 11, L 1    | Hardwood                   | Charcoal    | 0.28          | -        |                                    |
| 10072b-003          | CH 3B, T26, U 11, L 1    | Lauraceae                  | Charcoal    | 0.07          | -        |                                    |
| 10073-001           | CH 3B, T 26, U 11, L 3   | <i>Pinus</i> sp.           | Charcoal    | 0.15          | -        |                                    |
| 10073-002           | CH 3B, T 26, U 11, L 3   | <i>Allophylus</i> sp.      | Charcoal    | 0.09          | -        |                                    |
| 10073-003           | CH 3B, T 26, U 11, L 3   | <i>Tabernaemontana</i> sp. | Charcoal    | 1.03          | -        |                                    |

| 10073-004     | CH 3B, T 26, U 11, L 3 | Meliaceae                  | Charcoal   | 0.56   | - |                       |
|---------------|------------------------|----------------------------|------------|--------|---|-----------------------|
| 10073-005     | CH 3B, T 26, U 11, L 3 | <i>Byrsonima</i> sp.       | Charcoal   | 0.17   | - |                       |
| 10074-001     | CH 3B, T 26, U 11, L 4 | <i>Pinus</i> sp.           | Charcoal   | 0.08   | - |                       |
| 10074-002     | CH 3B, T 26, U 11, L 4 | Meliaceae                  | Charcoal   | 0.26   | - |                       |
| 10074-003     | CH 3B, T 26, U 11, L 4 | <i>Byrsonima</i> sp.       | Charcoal   | 0.08   | - |                       |
| 10075-001     | CH 3B, T 26, U 11, L 4 | <i>Pinus</i> sp.           | Charcoal   | 0.11   | - |                       |
| 10075-002     | CH 3B, T 26, U 11, L 4 | Hardwood                   | Charcoal   | 0.01   | - |                       |
| 10075-003     | CH 3B, T 26, U 11, L 4 | Hardwood                   | Charcoal   | 0.01   | - |                       |
| 10076-001     | CH 3B, T 26, U 11, L 6 | <i>Byrsonima</i> sp.       | Charcoal   | 0.11   | - | Floor                 |
| 10076-002     | CH 3B, T 26, U 11, L 6 | <i>Tabernaemontana</i> sp. | Charcoal   | 0.31   | - | Floor                 |
| 10076-003     | CH 3B, T 26, U 11, L 6 | <i>Zanthoxylum</i> sp.     | Charcoal   | 0.26   | - | Floor                 |
| 10076-004     | CH 3B, T 26, U 11, L 6 | cf. Rubiaceae              | Charcoal   | 0.04   | - | Floor                 |
| 10076-005     | CH 3B, T 26, U 11, L 6 | Hardwood                   | Charcoal   | 0.07   | - | Floor                 |
| 10076-006     | CH 3B, T 26, U 11, L 6 | <i>Zanthoxylum</i> sp.     | Charcoal   | 0.2    | - | Floor                 |
| 10076-007     | CH 3B, T 26, U 11, L 6 | <i>Tabernaemontana</i> sp. | Charcoal   | 0.11   | - | Floor                 |
| 10077-001     | CH 3B, U 12, L 3       | Hardwood                   | Charcoal   | 0.04   | - |                       |
| 10077-002     | CH 3B, U 12, L 3       | Rubiaceae                  | Charcoal   | 0.07   | - |                       |
| 10077-003     | CH 3B, U 12, L 3       | Hardwood                   | Charcoal   | 0.48   | - |                       |
| 10077-004     | CH 3B, U 12, L 3       | <i>Protium</i> sp.         | Charcoal   | 0.11   | - |                       |
| 10077-005     | CH 3B, U 12, L 3       | <i>Byrsonima</i> sp.       | Charcoal   | 0.19   | - |                       |
| 10078-001     | CH 3B, U 12-ext, L 3   | Sapotaceae                 | Charcoal   | 0.55   | - | Below Cache           |
| 10078-002     | CH 3B, U 12-ext, L 3   | Meliaceae                  | Charcoal   | 0.14   | - |                       |
| 10078-003     | CH 3B, U 12-ext, L 3   | Anacardiaceae              | Charcoal   | 0.43   | - | <i>Spondias</i> sp. ? |
| 10078-004     | CH 3B, U 12-ext, L 3   | <i>Tabernaemontana</i> sp. | Charcoal   | 0.16   | - |                       |
| 10078-005     | CH 3B, U 12-ext, L 3   | Hardwood                   | Charcoal   | 0.31   | - |                       |
| 10078-005     | CH 3B, U 12-ext, L 3   | Hardwood                   | Charcoal   | 0.35   | - |                       |
| 10078-006     | CH 3B, U 12-ext, L 3   | Hardwood                   | Charcoal   | 0.18   | - |                       |
| 10079-001     | CH 3B, U 12, L 4       | <i>Cassia</i> sp.          | Charcoal   | 0.94   | - |                       |
| 10079-002     | CH 3B, U 12, L 4       | Leguminosae                | Charcoal   | 0.69   | - |                       |
| 10079-003     | CH 3B, U 12, L 4       | <i>Byrsonima</i> sp.       | Charcoal   | 0.17   | - |                       |
| 10079-004     | CH 3B, U 12, L 4       | Hardwood                   | Charcoal   | 0.93   | - |                       |
| 10079-005     | CH 3B, U 12, L 4       | <i>Licaria</i> sp.         | Charcoal   | 0.43   | - |                       |
| 10079-006     | CH 3B, U 12, L 4       | Euphorbiaceae              | Charcoal   | 1.34   | - |                       |
| 10079-007     | CH 3B, U 12, L 4       | <i>Matayba</i> sp.         | Charcoal   | 0.94   | - |                       |
| 10079-008     | CH 3B, U 12, L 4       | <i>Matayba</i> sp.         | Charcoal   | 0.14   | - |                       |
| 10079-009     | CH 3B, U 12, L 4       | <i>Tabernaemontana</i>     | Charcoal   | 0.71   | - |                       |
| 10079-010     | CH 3B, U 12, L 4       | Hardwood                   | Charcoal   | 1.67   | - |                       |
| 10079-011     | CH 3B, U 12, L 4       | Rubiaceae                  | Charcoal   | 0.23   | - |                       |
| 10079-012     | CH 3B, U 12, L 4       | <i>Tabernaemontana</i> sp. | Charcoal   | 1.14   | - |                       |
| 10079-013     | CH 3B, U 12, L 4       | Araliaceae                 | Charcoal   | 0.22   | - |                       |
| 10079-014     | CH 3B, U 12, L 4       | Hardwood                   | Charcoal   | 0.47   | - |                       |
| 10079-015     | CH 3B, U 12, L 4       | <i>Zanthoxylum</i> sp.     | Charcoal   | 0.38   | - |                       |
|               |                        |                            |            |        |   |                       |
| Actun Nak Beh |                        |                            |            |        |   |                       |
| I.D. Number   | Provenience            | Plant                      | Plant Part | Weight | # | Comments              |
| 20001-001     | E1, U1, L1             | Fresh water mollusk        | -          | 0.05   | - | Disturbed             |
| 20001-002     | E1, U1, L1             | Meliaceae                  | Charcoal   | 0.01   | - | Disturbed             |
| 20001-003     | E1, U1, L1             | <i>Pinus</i> sp.           | Charcoal   | 0.01   | - | Disturbed             |
| 20001-004     | E1, U1, L1             | Arecaceae                  | Endocarp   | 0.01   | - | Disturbed             |
| 20002-001     | E1, U1, L3             | <i>Pinus</i> sp.           | Charcoal   | 0.01   | - | Disturbed             |
| 20002-002     | E1, U1, L3             | <i>Schizolobium</i>        | Charcoal   | 0.01   | - | Disturbed             |

|                       |                       |                              |                    |               |          |                 |
|-----------------------|-----------------------|------------------------------|--------------------|---------------|----------|-----------------|
|                       |                       | <i>parahyba</i>              |                    |               |          |                 |
| 20002-003             | E1, U1, L3            | Lauraceae                    | Charcoal           | 0.03          | -        | Disturbed       |
| 20003-001             | E1, U1, L4            | <i>Pinus</i> sp.             | Charcoal           | 0.01          | -        | Disturbed       |
| 20003-002             | E1, U1, L4            | Lauraceae                    | Charcoal           | 0.01          | -        | Disturbed       |
| 20003-003             | E1, U1, L4            | Unknown                      | Carbonized Residue | 0.01          | -        | Disturbed       |
| 20004-001             | E1, U1, L5            | <i>Pinus</i> sp.             | Charcoal           | 0.7           | -        |                 |
| 20004-002             | E1, U1, L5            | <i>Attalea cohune</i>        | Endocarp           | 0.03          | -        |                 |
| 20004-003             | E1, U1, L5            | Unknown                      | Carbonized Residue | 0.04          | -        |                 |
| 20004-004             | E1, U1, L5            | Meliaceae                    | Charcoal           | 0.01          | -        |                 |
| 20004-005             | E1, U1, L5            | Combretaceae                 | Charcoal           | 0.01          | -        |                 |
| 20005-001             | E1, U1, L6            | <i>Pinus</i> sp.             | Charcoal           | 0.27          | -        |                 |
| 20005-002             | E1, U1, L6            | Dicot                        | Charcoal           | 0.02          | -        |                 |
| 20006-001             | E1, U1, L7            | <i>Pinus</i> sp.             | Charcoal           | 0.35          | -        |                 |
| 20006-002             | E1, U1, L7            | <i>Attalea cohune</i>        | Endocarp           | 0.01          | -        |                 |
| 20007-001             | E1, U1-ext, L7        | <i>Pinus</i> sp.             | Charcoal           | 0.06          | -        |                 |
| 20007-002             | E1, U1-ext, L7        | <i>Byrsonima crassifolia</i> | Charcoal           | 0.01          | -        |                 |
| 20007-003             | E1, U1-ext, L7        | Meliaceae                    | Charcoal           | 0.01          | -        |                 |
| 20007-004             | E1, U1-ext, L7        | Poaceae                      | Seed               | > 0.01        | 1        |                 |
| 20008-001             | E1, U1-ext, L8        | <i>Pinus</i> sp.             | Charcoal           | 1.47          | -        |                 |
| 20008-002             | E1, U1-ext, L8        | Unknown                      | Residue            | 0.09          | -        |                 |
| 20008-003             | E1, U1-ext, L8        | <i>Attalea cohune</i>        | Endocarp           | 0.02          | -        |                 |
| 20008-004             | E1, U1-ext, L8        | Compositae                   | Seed               | > 0.01        | 1        |                 |
| 20009-001             | E1, U2, L1            | <i>Attalea cohune</i>        | Endocarp           | 1.28          | -        | Disturbed       |
| 20009-002             | E1, U2, L1            | <i>Pinus</i> sp.             | Charcoal           | 0.03          | -        | Disturbed       |
| 20009-003             | E1, U2, L1            | Unknown                      | Residue            | 0.02          | -        | Disturbed       |
| 20010-001             | E1, U2, L2            | <i>Attalea cohune</i>        | Endocarp           | 3.93          | -        | Disturbed       |
| 20010-002             | E1, U2, L2            | <i>Pinus</i> sp.             | Charcoal           | > 0.01        | -        | Disturbed       |
| 20011-001             | E1, U2, L4            | <i>Pinus</i> sp.             | Charcoal           | 0.04          | -        |                 |
| 20011-002             | E1, U2, L4            | Arecaceae                    | Endocarp           | 0.04          | -        |                 |
| 20012-001             | E1, U2, L5            | <i>Pinus</i> sp.             | Charcoal           | 0.06          | -        |                 |
| 20012-002             | E1, U2, L5            | Arecaceae                    | Endocarp           | > 0.01        | -        |                 |
| 20013-001             | E1, U2, L7            | <i>Pinus</i> sp.             | Charcoal           | 0.18          | -        |                 |
| 20014-001             | E1, U3, L2            | <i>Pinus</i> sp.             | Charcoal           | 0.02          | -        | Disturbed       |
| 20014-002             | E1, U3, L2            | Arecaceae                    | Endocarp           | 0.01          | -        | Disturbed       |
| 20014-003             | E1, U3, L2            | Unknown                      | Residue            | > 0.01        | -        | Disturbed       |
| 20014-004             | E1, U3, L2            | Hardwood                     | Charcoal           | > 0.01        | -        | Disturbed       |
| 20015-001             | CH1, U6, L2           | Unknown                      | Residue            | 0.22          | -        |                 |
| 20015-002             | CH1, U6, L2           | <i>Pinus</i> sp.             | Charcoal           | 0.41          | -        |                 |
| 20015-003             | CH1, U6, L2           | Hardwood                     | Charcoal           | > 0.01        | -        |                 |
| 20016-001             | CH5, U7, L2           | <i>Pinus</i> sp.             | Charcoal           | 0.11          | -        |                 |
| 20016-002             | CH5, U7, L2           | Unknown                      | Residue            | > 0.01        | -        |                 |
| 20016-003             | CH5, U7, L2           | Poaceae                      | Seed               | > 0.01        | -        |                 |
| 20016-004             | CH5, U7, L2           | Unknown                      | Seed               | > 0.01        | -        |                 |
| 20017-001             | CH5, U7, L5           | <i>Pinus</i> sp.             | Charcoal           | 0.03          | -        |                 |
| 20017-002             | CH5, U7, L5           | Unknown                      | Residue            | > 0.01        | -        |                 |
| 20017-003             | CH5, U7, L5           | Hardwood                     | Charcoal           | > 0.01        | -        |                 |
| 20017-004             | CH5, U7, L5           | Dicot                        | Rind               | > 0.01        | -        |                 |
| 20018-001             | CH5, U7, L7           | <i>Pinus</i> sp.             | Charcoal           | 0.18          | -        |                 |
|                       |                       |                              |                    |               |          |                 |
| <b>Tarantula Cave</b> |                       |                              |                    |               |          |                 |
| <b>I.D. Number</b>    | <b>Provenience</b>    | <b>Plant</b>                 | <b>Plant Part</b>  | <b>Weight</b> | <b>#</b> | <b>Comments</b> |
| 20019-001             | Passage 9, Cluster 67 | <i>Pinus</i> sp.             | Charcoal           | 0.62          | -        |                 |

| 20019-002           | Passage 9, Cluster 67  | Hardwood                     | Charcoal          | 0.03          | -        |                    |
|---------------------|------------------------|------------------------------|-------------------|---------------|----------|--------------------|
| 20019-003           | Passage 9, Cluster 67  | Hardwood                     | Charcoal          | 0.02          | -        |                    |
| 20019-004           | Passage 9, Cluster 67  | Sapotaceae                   | Charcoal          | 0.09          | -        |                    |
| 20019-005           | Passage 9, Cluster 67  | Unknown                      | Residue           | 0.04          | -        |                    |
| 20020-001           | Passage 9, Cluster 67  | <i>Pinus</i> sp.             | Charcoal          | 0.18          | -        |                    |
| 20020-002           | Passage 9, Cluster 67  | Lauraceae                    | Charcoal          | 0.08          | -        |                    |
| 20020-003           | Passage 9, Cluster 67  | Sapotaceae                   | Charcoal          | 0.22          | -        |                    |
| 20020-004           | Passage 9, Cluster 67  | Dicot                        | Charcoal          | 0.02          | -        |                    |
| 20021-001           | Passage 9, Cluster 67  | <i>Pinus</i> sp.             | Charcoal          | 0.34          | -        |                    |
| 20021-002           | Passage 9, Cluster 67  | Hardwood                     | Charcoal          | > 0.01        | -        |                    |
| 20021-003           | Passage 9, Cluster 67  | Bignoniaceae                 | Charcoal          | 0.17          | -        |                    |
| 20021-004           | Passage 9, Cluster 67  | Hardwood                     | Charcoal          | > 0.01        | -        |                    |
| 20021-005           | Passage 9, Cluster 67  | Sapotaceae                   | Charcoal          | 0.64          | -        |                    |
| 20021-006           | Passage 9, Cluster 67  | Dicot                        | Charcoal          | 0.08          | -        |                    |
| 20022-001           | Passage 9, Cluster 67  | <i>Pinus</i> sp.             | Charcoal          | 0.72          | -        |                    |
| 20022-002           | Passage 9, Cluster 67  | Hardwood                     | Charcoal          | 0.28          | -        |                    |
| 20022-003           | Passage 9, Cluster 67  | Hardwood                     | Charcoal          | > 0.01        | -        |                    |
| 20022-004           | Passage 9, Cluster 67  | <i>Enterolobium</i> sp.      | Charcoal          | 0.11          | -        |                    |
| 20022-005           | Passage 9, Cluster 67  | <i>Aspidosperma</i> sp.      | Charcoal          | 0.08          | -        |                    |
| 20022-006           | Passage 9, Cluster 67  | <i>Cordia</i> sp.            | Charcoal          | 2.08          | -        |                    |
|                     |                        |                              |                   |               |          |                    |
| <b>Twin Caves 2</b> |                        |                              |                   |               |          |                    |
| <b>I.D. Number</b>  | <b>Provenience</b>     | <b>Plant</b>                 | <b>Plant Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b>    |
| 20023-001           | West End Alcove Hearth | <i>Spondias</i> sp.          | Fruit pit         | 0.7           | -        | Ash from hearth    |
| 20023-002           | West End Alcove Hearth | <i>Pinus</i> sp.             | Charcoal          | 0.57          | -        | Ash from hearth    |
| 20023-003           | West End Alcove Hearth | Dicot                        | Charcoal          | 0.03          | -        | Ash from hearth    |
| 20023-004           | West End Alcove Hearth | Hardwood                     | Charcoal          | 0.05          | -        | Ash from hearth    |
| 20023-005           | West End Alcove Hearth | Rodent feces                 | -                 | 0.26          | -        | Ash from hearth    |
| 20023-006           | West End Alcove Hearth | <i>Passiflora</i> sp.        | Seed              | > 0.01        | 1        | Ash from hearth    |
| 20023-007           | West End Alcove Hearth | Insect appendage             | -                 | 0.01          | -        | Ash from hearth    |
| 20024-001           | West End Alcove Hearth | <i>Pinus</i> sp.             | Charcoal          | 2.3           | -        | Matrix from hearth |
| 20024-002           | West End Alcove Hearth | <i>Tabernaemontana</i> sp.   | Charcoal          | > 0.01        | -        | Matrix from hearth |
| 20024-003           | West End Alcove Hearth | Rodent feces                 | -                 | 0.32          | -        | Matrix from hearth |
| 20024-004           | West End Alcove Hearth | <i>Byrsonima crassifolia</i> | Seed              | 0.05          | 1        | Matrix from hearth |
| 20024-005           | West End Alcove Hearth | <i>Spondias</i> sp.          | Fruit pit         | 0.6           | > 1      | Matrix from hearth |
| 20024-006           | West End Alcove Hearth | <i>Protium</i> sp.           | Seed              | 0.01          | 1        | Matrix from hearth |
| 20024-007           | West End Alcove Hearth | Insect appendage             | -                 | 0.03          | -        | Matrix from hearth |
|                     |                        |                              |                   |               |          |                    |
| <b>Actun Halal</b>  |                        |                              |                   |               |          |                    |
| <b>I.D. Number</b>  | <b>Provenience</b>     | <b>Plant</b>                 | <b>Plant Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b>    |
| 20025-001           | E2, U1, L1             | <i>Pinus</i> sp.             | Charcoal          | 0.03          | -        |                    |
| 20025-002           | E2, U1, L1             | Hardwood                     | Charcoal          | > 0.01        | -        |                    |
| 20025-003           | E2, U1, L1             | Hardwood                     | Charcoal          | > 0.01        | -        |                    |
| 20025-003           | E2, U1, L1             | Arecaceae                    | Endocarp          | 0.02          | -        |                    |
| 20026-001           | E2, U1, L2             | Freshwater mollusks          | -                 | 0.11          | 5        |                    |
| 20026-002           | E2, U1, L2             | Dicot                        | Rootlets          | 0.08          | -        | Uncarbonized       |

| 20026-003                | E2, U1, L2               | Verbenaceae             | Fruit pit | 0.21   | 1  | Uncarbonized        |
|--------------------------|--------------------------|-------------------------|-----------|--------|----|---------------------|
| 20026-004                | E2, U1, L2               | <i>Pinus</i> sp.        | Charcoal  | 0.02   | -  |                     |
| 20026-005                | E2, U1, L2               | Dicot                   | Charcoal  | 0.01   | -  |                     |
| 20026-006                | E2, U1, L2               | Araliaceae              | Charcoal  | 0.01   | -  |                     |
| 20026-007                | E2, U1, L2               | Hardwood                | Charcoal  | 0.01   | -  |                     |
| 20027-001                | E2, U1, L3               | Dicot                   | Rootlets  | 0.21   | -  | Uncarbonized        |
| 20027-002                | E2, U1, L3               | <i>Pinus</i> sp.        | Charcoal  | 0.09   | -  |                     |
| 20027-003                | E2, U1, L3               | Sapotaceae              | Charcoal  | > 0.01 | -  |                     |
| 20028-001                | E2, U1, L4               | <i>Pinus</i> sp.        | Charcoal  | > 0.01 | -  |                     |
| 20028-002                | E2, U1, L4               | Araliaceae              | Charcoal  | 0.01   | -  |                     |
| 20029-001                | E2, U1, L5B              | Araliaceae              | Charcoal  | 0.37   | -  |                     |
| 20029-002                | E2, U1, L5B              | <i>Pouteria</i> sp.     | Charcoal  | > 0.01 | -  |                     |
| 20030-001                | E1, U2, L2               | <i>Pinus</i> sp.        | Charcoal  | > 0.01 | -  |                     |
| 20030-002                | E1, U2, L2               | Hardwood                | Charcoal  | 0.07   | -  |                     |
| 20031-001                | E1, U2, L2, NE           | <i>Pinus</i> sp.        | Charcoal  | 0.05   | -  | Northeast section   |
| 20031-002                | E1, U2, L2, NE           | Arecaceae               | Endocarp  | 0.01   | -  | Northeast section   |
| 20031-003                | E1, U2, L2, NE           | Hardwood                | Charcoal  | 0.04   | -  | Northeast section   |
| 20031-004                | E1, U2, L2, NE           | Combretaceae            | Charcoal  | 0.01   | -  | Northeast section   |
| 20032-001                | E1, U3, L2               | Verbenaceae             | Fruit pit | 1.23   | -  | Uncarbonized        |
| 20032-002                | E1, U3, L2               | Hardwood                | Charcoal  | 0.19   | -  |                     |
| 20032-003                | E1, U3, L2               | <i>Pinus</i> sp.        | Charcoal  | 0.06   | -  |                     |
| 20032-004                | E1, U3, L2               | Verbenaceae             | Endocarp  | 0.03   | -  |                     |
| 20033-001                | E1, U6, L1               | Compositae              | Seed      | > 0.01 | 1  |                     |
| 20033-002                | E1, U6, L1               | Freshwater mollusks     | -         | 0.24   | -  |                     |
| 20033-003                | E1, U6, L1               | Hardwood                | Charcoal  | 0.08   | -  |                     |
| 20034-001                | E2, U4, L2               | <i>Pinus</i> sp.        | Charcoal  | 0.1    | -  |                     |
| 20034-002                | E2, U4, L2               | Verbenaceae             | Endocarp  | 0.18   | -  |                     |
| 20034-003                | E2, U4, L2               | <i>Lonchocarpus</i> sp. | Charcoal  | 0.01   | -  |                     |
| 20034-004                | E2, U4, L2               | Leguminosae             | Seed      | > 0.01 | 1  |                     |
| 20034-005                | E2, U4, L2               | Poaceae                 | Caryopsis | > 0.01 | -  |                     |
| 20035                    | E1, U6, L2               | Sterile                 | -         | -      | -  |                     |
|                          |                          |                         |           |        |    |                     |
| <b>Barton Creek Cave</b> |                          |                         |           |        |    |                     |
| ID Number                | Provenience              | Plant                   | Part      | Weight | #  | Comments            |
| 20036-001                | Ledge 3, Area A, BC 26   | <i>Pinus</i> sp.        | Charcoal  | 0.61   | -  |                     |
| 20036-002                | Ledge 3, Area A, BC 26   | <i>Zea mays</i>         | Kernels   | 0.36   | -  | All very fragmented |
| 20036-003                | Ledge 3, Area A, BC 26   | Burseraceae             | Charcoal  | 0.03   | -  |                     |
| 20036-004                | Ledge 3, Area A, BC 26   | <i>Pouteria</i> sp.     | Charcoal  | 0.12   | -  |                     |
| 20037-001                | Ledge 3, Area A, BC 26   | <i>Zea mays</i>         | Kernels   | 0.36   | -  | All very fragmented |
| 20037-002                | Ledge 3, Area A, BC 26   | <i>Pinus</i> sp.        | Charcoal  | 0.13   | -  |                     |
| 20038-001                | Ledge 2, Feature 23, CC3 | <i>Zea mays</i>         | Shoots    | 24.06  | -  | Shoot fragments     |
| 20038-002                | Ledge 2, Feature 23, CC3 | <i>Gossypium</i> sp.    | Fibers    | -      | -  | Textile fragment    |
| 20038-003                | Ledge 2, Feature 23, CC3 | <i>Zea mays</i>         | Kernels   | 0.51   | 23 |                     |
| 20038-004                | Ledge 2, Feature 23, CC3 | <i>Protium</i> sp.      | Charcoal  | 6.82   | -  |                     |
| 20038-005                | Ledge 2, Feature 23, CC3 | <i>Protium</i> sp.      | Charcoal  | 0.87   | -  |                     |
| 20038-006                | Ledge 2, Feature 23, CC3 | Unknown                 | Residue   | 6.11   | -  |                     |

|            |                                 |                           |            |        |     |                               |
|------------|---------------------------------|---------------------------|------------|--------|-----|-------------------------------|
| 20038-007  | Ledge 2, Feature 23, CC3        | <i>Zea mays</i>           | Cobs       | 0.54   | 3   | Basal cob fragments           |
| 20038a-001 | Ledge 2, Feature 23, CC5        | <i>Zea mays</i>           | kernels    | 0.02   | 2   |                               |
| 20038a-002 | Ledge 2, Feature 23, CC5        | Monocot                   | stems      | 6.11   | -   |                               |
| 20038a-003 | Ledge 2, Feature 23, CC5        | Hardwood                  | Charcoal   | 0.07   | -   |                               |
| 20039-001  | Ledge 8, Area B, BC1            | <i>Pinus</i> sp.          | Charcoal   | 1.16   | -   |                               |
| 20039-002  | Ledge 8, Area B, BC1            | Sapotaceae                | Charcoal   | 2.91   | -   |                               |
| 20039-003  | Ledge 8, Area B, BC1            | Burseraceae               | Charcoal   | 0.61   | -   |                               |
| 20039-004  | Ledge 8, Area B, BC1            | Lauraceae                 | Charcoal   | 0.06   | -   |                               |
| 20039-005  | Ledge 8, Area B, BC1            | <i>Zea mays</i>           | Kernels    | 0.07   | 3   |                               |
| 20039-006  | Ledge 8, Area B, BC1            | <i>Zea mays</i>           | Cupules    | 0.02   | 6   |                               |
| 20039-007  | Ledge 8, Area B, BC1            | <i>Zea mays</i>           | Cob        | > 0.01 | 1   | Incomplete cob                |
| 20039-008  | Ledge 8, Area B, BC1            | Human bone                | phlange    | 0.94   | -   |                               |
| 20040-001  | Ledge 7, Area A, Unit 3, Hearth | <i>Pinus</i> sp.          | Charcoal   | 0.08   | -   |                               |
| 20040-002  | Ledge 7, Area A, Unit 3, Hearth | <i>Zea mays</i>           | Kernels    | 0.04   | -   | All very fragmented           |
| 20040-003  | Ledge 7, Area A, Unit 3, Hearth | Sapotaceae                | Charcoal   | 0.02   | -   |                               |
| 20040-004  | Ledge 7, Area A, Unit 3, Hearth | <i>Terminalia</i> sp.     | Charcoal   | 0.04   | -   |                               |
| 20041-001  | Ledge 6, Area A, Unit 2         | <i>Piscidia</i> sp.       | Charcoal   | 8.98   | -   |                               |
| 20041-002  | Ledge 6, Area A, Unit 2         | <i>Pinus</i> sp.          | Charcoal   | 1.49   | -   |                               |
| 20041-003  | Ledge 6, Area A, Unit 2         | Hardwood                  | Charcoal   | 2.01   | -   |                               |
| 20041-004  | Ledge 6, Area A, Unit 2         | <i>Lysiloma</i> sp.       | Charcoal   | 1.06   | -   |                               |
| 20041-005  | Ledge 6, Area A, Unit 2         | Burseraceae               | Charcoal   | 0.83   | -   |                               |
| 20042-001  | Ledge 2, Feature 23, CC2        | <i>Zea mays</i>           | Kernels    | 2.66   | 35  |                               |
| 20042-002  | Ledge 2, Feature 23, CC2        | <i>Zea mays</i>           | Cob        | 0.02   | 1   | Basal cob                     |
| 20042-003  | Ledge 2, Feature 23, CC2        | <i>Zea mays</i>           | Shoots     | 0.91   | -   | Shoot fragments               |
| 20042-004  | Ledge 2, Feature 23, CC2        | <i>Pinus</i> sp.          | Charcoal   | 0.36   | -   |                               |
| 20042-005  | Ledge 2, Feature 23, CC2        | <i>Zanthoxylum</i> sp.    | Charcoal   | 0.83   | -   |                               |
| 20042-006  | Ledge 2, Feature 23, CC2        | Weedy genus               | Charcoal   | 4.11   | -   | Non-Zea mays shoot fragments  |
| 20043-001  | Ledge 2, Feature 23, CC6        | <i>Cucurbita</i> sp.      | Rind       | 0.29   | -   |                               |
| 20043-002  | Ledge 2, Feature 23, CC6        | <i>Zea mays</i>           | Shoots     | 0.82   | -   | Shoot fragments               |
| 20043-003  | Ledge 2, Feature 23, CC6        | <i>Zea mays</i>           | Cupules    | 0.08   | 7   |                               |
| 20043-004  | Ledge 2, Feature 23, CC6        | Weedy genus               | Charcoal   | 0.49   | -   | Non-Zea mays shoot fragments  |
| 20043-005  | Ledge 2, Feature 23, CC6        | <i>Cucurbita moschata</i> | Seeds      | 0.02   | 1   | 1 complete seed and fragments |
| 20043-006  | Ledge 2, Feature 23, CC6        | <i>Capsicum annuum</i>    | Seeds      | 0.06   | 41  |                               |
| 20043-007  | Ledge 2, Feature 23, CC6        | <i>Cucurbita pepo</i>     | Seeds      | 0.3    | 1   | 1 complete seed and fragments |
| 20043-008  | Ledge 2, Feature 23, CC6        | <i>Zea mays</i>           | Kernels    | 7.09   | 129 |                               |
| 20043-009  | Ledge 2, Feature 23, CC6        | cf. <i>Phaseolus</i> sp.  | Cotyledon  | 0.01   | -   |                               |
| 20043-010  | Ledge 2, Feature 23, CC6        | <i>Capsicum</i> sp.       | Fruit base | 0.01   | 1   | Calyx intact                  |
| 20043-011  | Ledge 2, Feature 23, CC6        | Weedy genus               | Charcoal   | 0.01   | -   | 1 shoot fragment              |
| 20043-012  | Ledge 2, Feature 23, CC6        | <i>Cucurbita</i> sp.      | Seed       | > 0.01 | -   | Very fragmented               |



|                     |                          |                           |             |               |          |                              |
|---------------------|--------------------------|---------------------------|-------------|---------------|----------|------------------------------|
| 20043-013           | Ledge 2, Feature 23, CC6 | <i>Vitis tiliifolia</i>   | Seed        | > 0.01        | -        |                              |
| 20043-014           | Ledge 2, Feature 23, CC6 | Dicot                     | Floral buds | 0.03          | 4        |                              |
| 20043-015           | Ledge 2, Feature 23, CC6 | <i>Zanthoxylum</i> sp.    | Charcoal    | 3.86          | -        |                              |
| 20043-016           | Ledge 2, Feature 23, CC6 | <i>Pinus</i> sp.          | Charcoal    | 2.01          | -        |                              |
| 20044-001           | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>           | Kernels     | 5.29          | 55       |                              |
| 20044-002           | Ledge 2, Feature 23, CC1 | <i>Gossypium</i> sp.      | Fibers      | > 0.01        | 5        | Z-spun threads               |
| 20044-003           | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>           | Shoots      | 6.47          | -        | Shoot fragments              |
| 20044-004           | Ledge 2, Feature 23, CC1 | Weedy genus               | Charcoal    | 1.17          | -        | Non-Zea mays shoot fragments |
| 20044-005           | Ledge 2, Feature 23, CC1 | <i>Cucurbita pepo</i>     | Seed        | 0.12          | 1        |                              |
| 20044-006           | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>           | Cupules     | 0.13          | 13       | Some with glumes             |
| 20044-007           | Ledge 2, Feature 23, CC1 | <i>Zea mays</i>           | Cobs        | 0.18          | 2        | Underdeveloped, basal cobs   |
| 20044-008           | Ledge 2, Feature 23, CC1 | <i>Pinus</i> sp.          | Charcoal    | 0.02          | -        |                              |
| 20044-009           | Ledge 2, Feature 23, CC1 | Unknown                   | Seed        | 0.01          | 1        |                              |
| 20044-010           | Ledge 2, Feature 23, CC1 | Dicot                     | Floral bud  | 0.01          | 1        |                              |
| 20044-011           | Ledge 2, Feature 23, CC1 | <i>Pinus</i> sp.          | Charcoal    | 0.98          | -        |                              |
| 20044-012           | Ledge 2, Feature 23, CC1 | Hardwood                  | Charcoal    | 0.46          | -        |                              |
| 20044-013           | Ledge 2, Feature 23, CC1 | <i>Zanthoxylum</i> sp.    | Charcoal    | 1.68          | -        |                              |
| 20044-014           | Ledge 2, Feature 23, CC1 | Unknown                   | Unknown     | > 0.01        | -        | Possibly insect droppings    |
| 20045               | Ledge 3, Area A, AC 56   | Sterile                   | -           | -             | -        | All rodent droppings         |
| 20046-001           | Ledge 6, Area A, Unit 2  | <i>Pinus</i> sp.          | Charcoal    | 0.37          | -        |                              |
| 20046-002           | Ledge 6, Area A, Unit 2  | <i>Zea mays</i>           | Kernels     | 0.02          | -        | All very fragmented          |
| 20046-003           | Ledge 6, Area A, Unit 2  | <i>Piscidia</i> sp.       | Charcoal    | 2.88          | -        |                              |
| 20046-004           | Ledge 6, Area A, Unit 2  | <i>Cedrela</i> sp.        | Charcoal    | 0.92          | -        |                              |
| 20046-005           | Ledge 6, Area A, Unit 2  | <i>Byrsonima</i> sp.      | Charcoal    | 1.19          | -        |                              |
| 20046-006           | Ledge 6, Area A, Unit 2  | <i>Phaseolus vulgaris</i> | Seed        | 0.04          | 1        |                              |
| 20046-007           | Ledge 6, Area A, Unit 2  | <i>Byrsonima</i> sp.      | Charcoal    | 0.33          | -        |                              |
| 20046-008           | Ledge 6, Area A, Unit 2  | Lauraceae                 | Charcoal    | 0.5           | -        |                              |
| 20047-001           | Ledge 6, Area A, Unit 2  | <i>Pinus</i> sp.          | Charcoal    | 0.93          | -        |                              |
| 20047-002           | Ledge 6, Area A, Unit 2  | <i>Lonchocarpus</i> sp.   | Charcoal    | 0.62          | -        |                              |
| 20047-003           | Ledge 6, Area A, Unit 2  | <i>Byrsonima</i> sp.      | Charcoal    | 0.64          | -        |                              |
| 20047-004           | Ledge 6, Area A, Unit 2  | <i>Cedrela</i> sp.        | Charcoal    | 0.74          | -        |                              |
| 20047-005           | Ledge 6, Area A, Unit 2  | <i>Protium</i> sp.        | Charcoal    | 0.35          | -        |                              |
| 20047-006           | Ledge 6, Area A, Unit 2  | Dicot                     | Charcoal    | 1.32          | -        |                              |
| 20047-007           | Ledge 6, Area A, Unit 2  | Compositae                | Achene      | > 0.01        | 1        | 1 achene                     |
| 20047-008           | Ledge 6, Area A, Unit 2  | <i>Zea mays</i>           | Kernel      | > 0.01        | 1        | Underdeveloped kernel        |
| 20047-009           | Ledge 6, Area A, Unit 2  | Unknown                   | Disseminule | > 0.01        | 2        |                              |
| 20047-010           | Ledge 6, Area A, Unit 2  | Dicot                     | Rind        | 0.19          | -        |                              |
|                     |                          |                           |             |               |          |                              |
| <b>Actun Chapat</b> |                          |                           |             |               |          |                              |
| <b>ID Number</b>    | <b>Provenience</b>       | <b>Plant</b>              | <b>Part</b> | <b>Weight</b> | <b>#</b> | <b>Comments</b>              |
| 20048-001           | CH 3B, T 20, U 10, L 3   | <i>Pinus</i> sp.          | Charcoal    | 0.08          | -        |                              |
| 20048-002           | CH 3B, T 20, U 10, L 3   | <i>Piscidia</i> sp.       | Charcoal    | 0.08          | -        |                              |

|           |                        |                            |            |        |    |                                |
|-----------|------------------------|----------------------------|------------|--------|----|--------------------------------|
| 20048-003 | CH 3B, T 20, U 10, L 3 | <i>Albizia</i> sp.         | Charcoal   | 0.01   | -  |                                |
| 20048-004 | CH 3B, T 20, U 10, L 3 | Burseraceae                | Charcoal   | 0.03   | -  |                                |
| 20048-005 | CH 3B, T 20, U 10, L 3 | Hardwood                   | Charcoal   | 0.22   | -  |                                |
| 20048-006 | CH 3B, T 20, U 10, L 3 | <i>Zea mays</i>            | Cupules    | 0.03   | 16 | Some fragments                 |
| 20048-007 | CH 3B, T 20, U 10, L 3 | <i>Zea mays</i>            | Glumes     | 0.01   | 3  |                                |
| 20048-008 | CH 3B, T 20, U 10, L 3 | Dicot                      | Floral Bud | 0.01   | 1  |                                |
| 20048-009 | CH 3B, T 20, U 10, L 3 | Dicot                      | Rind       | > 0.01 | -  |                                |
| 20048-010 | CH 3B, T 20, U 10, L 3 | Unknown                    | Seed       | > 0.01 | 2  |                                |
| 20048-011 | CH 3B, T 20, U 10, L 3 | Dicot                      | Charcoal   | 0.01   | -  |                                |
| 20049-001 | CH 3B, T 20, U 10, L 4 | <i>Pinus</i> sp.           | Charcoal   | 0.1    | -  |                                |
| 20049-002 | CH 3B, T 20, U 10, L 4 | Mammal                     | Bones      | 0.03   | -  |                                |
| 20049-003 | CH 3B, T 20, U 10, L 4 | Hardwood                   | Charcoal   | 0.01   | -  |                                |
| 20049-004 | CH 3B, T 20, U 10, L 4 | <i>Protium</i> sp.         | Charcoal   | 0.06   | -  |                                |
| 20049-005 | CH 3B, T 20, U 10, L 4 | Hardwood                   | Charcoal   | 0.12   | -  |                                |
| 20049-006 | CH 3B, T 20, U 10, L 4 | <i>Zea mays</i>            | Kernels    | 0.01   | 4  | Fragments                      |
| 20049-007 | CH 3B, T 20, U 10, L 4 | <i>Zea mays</i>            | Cupules    | 0.01   | 6  | 2 with glumes intact           |
| 20049-008 | CH 3B, T 20, U 10, L 4 | <i>Zea mays</i>            | Cob        | 0.01   | 1  | Fragment with pubescent glumes |
| 20049-009 | CH 3B, T 20, U 10, L 4 | Unknown                    | Seed       | > 0.01 | 1  |                                |
| 20049-010 | CH 3B, T 20, U 10, L 4 | <i>Cucurbita</i> sp.       | Rind       | 0.01   | -  |                                |
| 20050-001 | CH 3B, T 20, U 10, L 6 | <i>Pinus</i> sp.           | Charcoal   | 0.06   | -  |                                |
| 20050-002 | CH 3B, T 20, U 10, L 6 | <i>Zea mays</i>            | Cupule     | > 0.01 | 1  |                                |
| 20051-001 | CH 3B, T 26, U 11, L 3 | <i>Pinus</i> sp.           | Charcoal   | 0.12   | -  | Disturbed                      |
| 20051-002 | CH 3B, T 26, U 11, L 3 | Leguminosae                | Charcoal   | 0.13   | -  | Disturbed                      |
| 20051-003 | CH 3B, T 26, U 11, L 3 | <i>Tabernaemontana</i> sp. | Charcoal   | 0.62   | -  | Disturbed                      |
| 20051-004 | CH 3B, T 26, U 11, L 3 | <i>Byrsonima</i> sp.       | Charcoal   | 0.07   | -  | Disturbed                      |
| 20052-001 | CH 3B, T 26, U 11, L 4 | <i>Pinus</i> sp.           | Charcoal   | 0.25   | -  | Disturbed                      |
| 20052-002 | CH 3B, T 26, U 11, L 4 | <i>Byrsonima</i> sp.       | Charcoal   | 0.03   | -  | Disturbed                      |
| 20052-003 | CH 3B, T 26, U 11, L 4 | Hardwood                   | Charcoal   | 0.29   | -  | Disturbed                      |
| 20052-004 | CH 3B, T 26, U 11, L 4 | Rubiaceae                  | Charcoal   | 0.56   | -  | Disturbed                      |
| 20053-001 | CH 3B, T 26, U 11, L 4 | Hardwood                   | Charcoal   | 0.13   | -  | Disturbed                      |
| 20053-002 | CH 3B, T 26, U 11, L 4 | Mammal                     | Bones      | 0.01   | -  | Disturbed                      |
| 20053-003 | CH 3B, T 26, U 11, L 4 | Unknown                    | Seed       | > 0.01 | 1  | Disturbed, seed uncarbonized   |
| 20054-001 | CH 3B, T 26, U 11, L 5 | <i>Pinus</i> sp.           | Charcoal   | > 0.01 | -  | Disturbed                      |
| 20054-002 | CH 3B, T 26, U 11, L 5 | Arecaceae                  | Charcoal   | 0.01   | -  | Disturbed                      |
| 20054-003 | CH 3B, T 26, U 11, L 5 | <i>Tabernaemontana</i> sp. | Charcoal   | 0.44   | -  | Disturbed                      |
| 20054-004 | CH 3B, T 26, U 11, L 5 | <i>Piscidia</i> sp.        | Charcoal   | > 0.01 | -  | Disturbed                      |
| 20054-005 | CH 3B, T 26, U 11, L 5 | Hardwood                   | Charcoal   | 0.06   | -  | Disturbed                      |
| 20055-001 | CH 3B, T 26, U 11, L 6 | <i>Zea mays</i>            | Kernels    | > 0.01 | 2  | Fragments                      |
| 20055-002 | CH 3B, T 26, U 11, L 6 | <i>Phaseolus</i> sp.       | Seed       | 0.01   | 1  |                                |
| 20055-003 | CH 3B, T 26, U 11, L 6 | <i>Pinus</i> sp.           | Charcoal   | 0.05   | -  |                                |
| 20055-004 | CH 3B, T 26, U 11, L 6 | Hardwood                   | Charcoal   | 0.12   | -  |                                |
| 20056-001 | CH 3B, T 26, U 11, L 6 | <i>Pinus</i> sp.           | Charcoal   | > 0.01 | -  |                                |
| 20056-002 | CH 3B, T 26, U 11, L 6 | <i>Piscidia</i> sp.        | Charcoal   | 0.05   | -  |                                |
| 20056-003 | CH 3B, T 26, U 11, L 6 | Hardwood                   | Charcoal   | 0.06   | -  |                                |
| 20056-004 | CH 3B, T 26, U 11, L 6 | <i>Cordia</i> sp.          | Charcoal   | 0.03   | -  |                                |
| 20057-001 | CH 3B, U 12, L 3       | <i>Pinus</i> sp.           | Charcoal   | 0.21   | -  |                                |
| 20057-002 | CH 3B, U 12, L 3       | <i>Zea mays</i>            | Kernels    | 0.04   | 5  | 4 fragments, 1 complete        |
| 20057-003 | CH 3B, U 12, L 3       | Hardwood                   | Charcoal   | 1.05   | -  |                                |

| 20057-004                 | CH 3B, U 12, L 3     | <i>Protium</i> sp.         | Charcoal   | 0.33                  | -  |                                           |
|---------------------------|----------------------|----------------------------|------------|-----------------------|----|-------------------------------------------|
| 20057-005                 | CH 3B, U 12, L 3     | <i>Byrsonima</i> sp.       | Charcoal   | 0.18                  | -  |                                           |
| 20057-006                 | CH 3B, U 12, L 3     | <i>Tabernaemontana</i> sp. | Charcoal   | 1.38                  | -  |                                           |
| 20057-007                 | CH 3B, U 12, L 3     | <i>Zanthoxylum</i> sp.     | Charcoal   | 0.07                  | -  |                                           |
| 20057-008                 | CH 3B, U 12, L 3     | Leguminosae                | Charcoal   | 0.21                  | -  |                                           |
| 20057-009                 | CH 3B, U 12, L 3     | Hardwood                   | Charcoal   | 4.16                  | -  |                                           |
| 20058-001                 | CH 3B, U 12-ext, L 3 | <i>Pinus</i> sp.           | Charcoal   | 0.03                  | -  |                                           |
| 20058-002                 | CH 3B, U 12-ext, L 3 | <i>Zea mays</i>            | Kernel     | > 0.01                | 1  | Fragment                                  |
| 20058-003                 | CH 3B, U 12-ext, L 3 | Dicot                      | Floral Bud | > 0.01                | 1  |                                           |
| 20058-004                 | CH 3B, U 12-ext, L 3 | <i>Piscidia</i> sp.        | Charcoal   | 0.11                  | -  |                                           |
| 20058-005                 | CH 3B, U 12-ext, L 3 | Sapotaceae                 | Charcoal   | 0.07                  | -  |                                           |
| 20058-006                 | CH 3B, U 12-ext, L 3 | Rubiaceae                  | Charcoal   | 0.14                  | -  |                                           |
| 20058-007                 | CH 3B, U 12-ext, L 3 | Hardwood                   | Charcoal   | 0.23                  | -  |                                           |
| 20059-001                 | CH 3B, U 12, L 4     | <i>Pinus</i> sp.           | Charcoal   | > 0.01                | -  |                                           |
| 20059-002                 | CH 3B, U 12, L 4     | <i>Zea mays</i>            | Kernels    | > 0.01                | 2  | Fragments                                 |
| 20059-003                 | CH 3B, U 12, L 4     | Euphorbiaceae              | Charcoal   | 0.99                  | -  |                                           |
| 20059-004                 | CH 3B, U 12, L 4     | <i>Tabernaemontana</i> sp. | Charcoal   | 1.47                  | -  |                                           |
| 20059-005                 | CH 3B, U 12, L 4     | <i>Byrsonima</i> sp.       | Charcoal   | 0.13                  | -  |                                           |
| 20059-007                 | CH 3B, U 12, L 4     | Hardwood                   | Charcoal   | 2.4                   | -  |                                           |
|                           |                      |                            |            |                       |    |                                           |
| <b>Actun Chechem Ha</b>   |                      |                            |            |                       |    |                                           |
| <b>1998 Samples</b>       |                      |                            |            |                       |    |                                           |
| Provenience               | Plant                | Part Found                 | Weight     | Vessel Number         | #  | Comments                                  |
| Ledge 4, Stone Circle # 8 | <i>Pinus</i> sp.     | Charcoal                   | 0.13       | -                     | -  | 1998 Sample # 9                           |
| Ledge 4, Stone Circle # 9 | <i>Pinus</i> sp.     | Charcoal                   | 0.14       | -                     | -  | 1998 Sample # 10                          |
| Ledge 6, Olla 3           | <i>Zea mays</i>      | Cobs                       | -          | Olla 3 (?)            | 4  | 1998 Sample # 1                           |
| Elevated Passage 3        | <i>Zea mays</i>      | Cobs                       | -          | ?                     | 3  | 1998 Sample # 8                           |
| Crawl 3                   | Unknown              | Residue                    | 25.06      | ?                     | -  | 1998 Sample # 7 (Submitted for FT-ICR MS) |
| Crawl 3, Hearth Feature   | <i>Pinus</i> sp.     | Charcoal                   | 5.19       |                       | -  | 1998 Sample # 6                           |
|                           | <i>Zea mays</i>      | Kernel                     | > 0.01     |                       | 1  |                                           |
| <b>1999 Samples</b>       |                      |                            |            |                       |    |                                           |
| Provenience               | Plant                | Part Found                 | Weight     | Vessel Number         | #  | Comments                                  |
| Ledge 5                   | Unknown              | Residue                    | 2.09       | 11013508              | -  | Sherd                                     |
| Ledge 7                   | <i>Pinus</i> sp.     | Charcoal                   | 0.22       | 12015701              | -  | Bowl: Mount Maloney Black                 |
|                           | <i>Solanum</i> sp.   | Seeds                      | 0.03       |                       | 71 | Uncarbonized                              |
|                           | <i>Piper</i> sp.     | Seeds                      | 0.01       |                       | 32 | Uncarbonized                              |
|                           | <i>Cecropia</i> sp.  | Seeds                      | 0.02       |                       | 40 | Uncarbonized                              |
| Ledge 10, Stack 7         | <i>Pinus</i> sp.     | Charcoal                   | 0.21       | 91031501 and 11035001 | -  | Between two stacked sherds                |
| Ledge 11, Stone Circle    | <i>Pinus</i> sp.     | Charcoal                   | 0.07       | -                     | -  | From shallow pit with stone circle        |
|                           | <i>Solanum</i> sp.   | Seeds                      | > 0.01     |                       | 7  | Uncarbonized                              |
|                           | <i>Piper</i> sp.     | Seeds                      | > 0.01     |                       | 8  | Uncarbonized                              |

|                                |                     |                   |               |                          |          |                                                       |
|--------------------------------|---------------------|-------------------|---------------|--------------------------|----------|-------------------------------------------------------|
|                                |                     |                   |               |                          |          | d                                                     |
|                                | Unknown             | Seeds             | 0.01          |                          | 21       | Uncarbonize<br>d                                      |
| Elevated<br>Passage 3          | <i>Pinus</i> sp.    | Charcoal          | 0.24          | -                        | -        | Under<br>overhang                                     |
| Chamber 3                      | <i>Pinus</i> sp.    | Charcoal          | 0.22          | 12026001                 | -        | Bowl:<br>Garbutt<br>Creek                             |
|                                | Unknown             | Concretion        | 0.01          |                          | -        |                                                       |
|                                | <i>Piper</i> sp.    | Seeds             | > 0.01        |                          | 23       | Uncarbonize<br>d                                      |
| <b>2000 Samples</b>            |                     |                   |               |                          |          |                                                       |
| <b>Provenience</b>             | <b>Plant</b>        | <b>Part Found</b> | <b>Weight</b> | <b>Vessel<br/>Number</b> | <b>#</b> | <b>Comments</b>                                       |
| Elevated<br>Passage 1, VC<br>1 | <i>Pinus</i> sp.    | Charcoal          | 0.02          | 11002201                 | -        | Jar: Cayo<br>Unslipped<br>(Late<br>Classic)           |
|                                | <i>Solanum</i> sp.  | Seeds             | > 0.01        |                          | 24       | Uncarbonize<br>d                                      |
|                                | <i>Piper</i> sp.    | Seeds             | 0.01          |                          | 91       | Uncarbonize<br>d                                      |
|                                | <i>Cecropia</i> sp. | Seeds             | > 0.01        |                          | 31       | Uncarbonize<br>d                                      |
| Elevated<br>Passage 1, VC<br>2 | <i>Pinus</i> sp.    | Charcoal          | 0.01          | 11002301                 | -        | Jar: Cayo<br>Unslipped<br>(Late<br>Classic)           |
|                                | <i>Solanum</i> sp.  | Seeds             | > 0.01        |                          | 23       | Uncarbonize<br>d                                      |
|                                | <i>Piper</i> sp.    | Seeds             | 0.03          |                          | 133      | Uncarbonize<br>d                                      |
| Elevated<br>Passage 1, VC<br>3 | <i>Pinus</i> sp.    | Charcoal          | 0.01          | 11002401                 | -        | Jar: Cayo<br>Unslipped<br>(Late<br>Classic)           |
|                                | <i>Solanum</i> sp.  | Seeds             | 0.06          |                          | 231      | Uncarbonize<br>d                                      |
|                                | <i>Cecropia</i> sp. | Seeds             | 0.03          |                          | 101      | Uncarbonize<br>d                                      |
|                                | Unknown             | Seeds             | 0.03          |                          | 79       | Uncarbonize<br>d                                      |
| Elevated<br>Passage 1, VC<br>4 | <i>Pinus</i> sp.    | Charcoal          | 0.02          | 11003001                 | -        | Jar:<br>Alexander's<br>Unslipped<br>(Late<br>Classic) |
|                                | <i>Solanum</i> sp.  | Seeds             | > 0.01        |                          | 4        | Uncarbonize<br>d                                      |
|                                | <i>Cecropia</i> sp. | Seeds             | > 0.01        |                          | 18       | Uncarbonize<br>d                                      |
| Elevated<br>Passage 1, VC<br>5 | Unknown             | Seeds             | 0.11          | 11004601                 | <<br>500 | Jar: Cayo<br>Unslipped<br>(Late<br>Classic)           |
| Elevated<br>Passage 1, VC<br>6 | <i>Pinus</i> sp.    | Charcoal          | 0.11          | 11001501                 | -        | Jar: Cayo<br>Unslipped<br>(Late<br>Classic)           |
|                                | <i>Solanum</i> sp.  | Seeds             | > 0.01        |                          | 20       | Uncarbonize<br>d                                      |
|                                | <i>Piper</i> sp.    | Seeds             | > 0.01        |                          | 67       | Uncarbonize<br>d                                      |
|                                | <i>Cecropia</i> sp. | Seeds             | 0.02          |                          | 47       | Uncarbonize<br>d                                      |
| Elevated<br>Passage 1, VC<br>7 | <i>Pinus</i> sp.    | Charcoal          | 0.01          | 11003401                 | -        | Jar: Cayo<br>Unslipped<br>(Late<br>Classic)           |
|                                | <i>Solanum</i> sp.  | Seeds             | > 0.01        |                          | 23       | Uncarbonize<br>d                                      |
|                                | <i>Piper</i> sp.    | Seeds             | 0.03          |                          | 133      | Uncarbonize<br>d                                      |
| Ledge 7, VC 1                  | <i>Solanum</i> sp.  | Seeds             | > 0.01        | 12015701                 | 4        | Bowl: Mount                                           |

|                         |                     |           |        |          |     |                                     |
|-------------------------|---------------------|-----------|--------|----------|-----|-------------------------------------|
|                         |                     |           |        |          |     | Maloney Black (LC II)               |
|                         | <i>Cecropia</i> sp. | Seeds     | > 0.01 |          | 18  | Uncarbonized                        |
|                         | <i>Piper</i> sp.    | Seeds     | > 0.01 |          | 21  | Uncarbonized                        |
|                         | Unknown             | Seeds     | > 0.01 |          | 17  | Uncarbonized                        |
| Ledge 7, VC 2           | <i>Pinus</i> sp.    | Charcoal  | > 0.01 | 11016101 | -   | Jar: Cayo Unslipped (Late Classic)  |
|                         | Unknown             | Residue   | 0.01   |          | -   |                                     |
|                         | <i>Solanum</i> sp.  | Seeds     | > 0.01 |          | 5   | Uncarbonized                        |
|                         | <i>Cecropia</i> sp. | Seeds     | > 0.01 |          | 31  | Uncarbonized                        |
|                         | Unknown             | Seeds     | > 0.01 |          | 18  | Uncarbonized                        |
| Ledge 7, VC 3           | <i>Pinus</i> sp.    | Charcoal  | 0.16   | 11017301 | -   | Jar: Zibal Unslipped (Late Classic) |
| Crawl 3, VC 1 (Hearth)  | <i>Pinus</i> sp.    | Charcoal  | 0.1    | 11045901 | -   | Jar: Zibal Unslipped (Late Classic) |
|                         | <i>Solanum</i> sp.  | Seeds     | > 0.01 |          | 8   | Uncarbonized                        |
|                         | <i>Piper</i> sp.    | Seeds     | > 0.01 |          | 17  | Uncarbonized                        |
| Crawl 3, Hearth Feature | <i>Pinus</i> sp.    | Charcoal  | 93     |          | -   | Flotation Sample                    |
|                         | <i>Zea mays</i>     | Kernels   | 0.02   |          | 4   | Uncarbonized                        |
|                         | <i>Solanum</i> sp.  | Seeds     | 0.02   |          | 41  | Uncarbonized                        |
|                         | Unknown             | Seeds     | 0.04   |          | 121 | Uncarbonized                        |
| Tunnel 2, VC 1          | <i>Pinus</i> sp.    | Charcoal  | 1.13   | 11050201 | -   | Jar: Cayo Unslipped (Late Classic)  |
| Tunnel 2, VC2           | <i>Pinus</i> sp.    | Charcoal  | 0.04   | 11048901 | -   | Jar: Cayo Unslipped (Late Classic)  |
|                         | Solanaceae          | Seeds     | > 0.01 |          | 2   | Uncarbonized                        |
|                         | Unknown             | Residue   | 1.36   |          | -   |                                     |
|                         | Mammal              | Droppings | 0.03   |          | -   |                                     |
| Tunnel 2, VC 3          | <i>Pinus</i> sp.    | Charcoal  | > 0.01 | 11050301 | -   | Jar: Cayo Unslipped (Late Classic)  |
|                         | Unknown             | Residue   | 0.12   |          | -   |                                     |
|                         | Unknown             | Fibers    | 0.22   |          | -   |                                     |
|                         | <i>Solanum</i> sp.  | Seeds     | > 0.01 |          | 1   | Uncarbonized                        |
|                         | <i>Cecropia</i> sp. | Seeds     | > 0.01 |          | 7   | Uncarbonized                        |
|                         | Unknown             | Seeds     | 0.03   |          | 57  | Uncarbonized                        |

## APPENDIX B

### DESCRIPTIONS OF MACROFLORAL REMAINS

The following appendix presents technical descriptions of identified macrofloral remains from the cave sites. For simplicity, taxa are organized alphabetically by botanical family rather than phylogenetically. Descriptions are organized from general to specific under each family. If macrofloral remains were identified only to the family then a technical description of those remains and a list of samples containing them is presented under the family heading. If more specific taxonomic identifications were made for taxa of the same family then those genera and species are listed below the family description. If genus or species level identifications were possible for all macrofloral remains of a given family then technical descriptions are provided only for those taxa and not for the more general family category.

The majority of descriptions focus on wood charcoal identified to the family, genus, or species. Wood charcoal identifications are based on the distribution and size of vessels, the size of rays, and the nature of axial parenchyma in cross-section. Other identified remains include seeds and fruit remains. Identification of these remains focused on size, shape, and surface texture. In some specimens, charring obscured surface characteristics. In uncharred specimens, however, seed surface texture and color were useful attributes for identification. Refer to Appendix E for definitions of descriptive terms used and to Appendix A and Chapter 5 for more in depth contextual information on the botanical remains. Furthermore, the reader is urged to examine the numerous photomicrographs and scanning electron micrographs of botanical remains presented in Chapter 5. Although the following descriptions are useful in understanding technical attributes and to verify identifications, there is no substitute for the opportunity to visually inspect identified botanical remains.

#### Anacardiaceae

One deposit from Actun Chapat contained hardwood charcoal identified as belonging to the family Anacardiaceae. The charcoal is anatomically similar to *Spondias mombin*. There are some similarities with *Metopium brownei* also, though the specimens' axial parenchyma is not as distinctly paratracheal as *M. brownei*. Furthermore, the sap of *M. brownei* is a powerful irritant so it seems unlikely that it would have been intentionally burned as a source of fuel. The Anacardiaceae charcoal is diffuse porous in cross-section. Vessels are solitary and in radial chains of two to four, between 8 and 12 per mm<sup>2</sup>. Vessels are between 150 and 180 µm in diameter. Rays are multiseriate, between three and five cells wide. Axial parenchyma is paratracheal.

**Common Names.** Unknown genera or species. See below for common names of *Spondias* sp.

**Sample Information.** Actun Chapat: 10078.

#### *Spondias* sp.

**Description.** A carbonized pit (pyrene) and pit fragments of *Spondias* sp. from Twin Caves 2 were the only archaeobotanical remains from the Anacardiaceae family identified to genus. With the exception of one nearly complete pit, the *Spondias* sp. remains are fragmentary. The intact pit is 18.2 mm long and 9.2 mm wide. Pit surface is diagnostic. The surface is irregularly reticulate with numerous stony protrusions.

**Common Names.** Hog plum (E), ciruela (S), cochino (S), *ab'al* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Twin Caves 2: 20023, 20024.

#### Apocynaceae

##### *Aspidosperma* sp.

**Description.** Charcoal specimens identified as *Aspidosperma* sp. are semi-ring to ring porous in cross-section with small vessels, between 40 and 60 µm in diameter. Vessels are mostly solitary but also in radial chains of two or three. Vessel density is high, between 30 and 60 per mm<sup>2</sup>. Rays are two to three cells wide. Axial parenchyma is unilateral paratracheal.

**Common Names.** Malady (S), *sa'yuk'* (M), *pich max* (M) (Arnason et al. 1980; Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10021, 10022a; Tarantula Cave: 20022; Barton Creek Cave: 10051; Actun Halal: 10006.

##### *Tabernaemontana* sp.

**Description.** *Tabernaemontana* sp. charcoal is semi-ring porous in cross-section with densely packed vessels, >150 per mm<sup>2</sup>. Vessels are small, between 25 and 50 µm, and are solitary and in radial chains of two to six. Rays mostly two to three cells wide. Axial parenchyma is scanty to unilateral paratracheal.

**Common Names.** Cojoton (S), *uts'upek'* (M) (Ankli et al. 1999; Balick et al. 2000).

**Sample Information.** Actun Chapat: 10073, 10076, 10078, 10079, 20051, 20054, 20057, 20059; Twin Caves 2: 20024.

#### Araliaceae

**Description.** Charcoal identified as Araliaceae were not identified to genus because it could not be determined whether archaeobotanical specimens were species of *Oreopanax* or *Dendropanax*. Wood of both genera are

anatomically similar, and insufficient modern wood samples were available during analysis to discriminate between the two genera. Araliaceae charcoal specimens are diffuse porous in cross-section and have small vessels between 40 and 60  $\mu\text{m}$  in diameter with approximately 50 per  $\text{mm}^2$ . Vessels are solitary, in radial chains of two to three, and in tangential clusters. Rays are uniseriate and multiseriate; multiseriate rays are between four and five cells wide. Axial parenchyma is not distinct but appears to be mostly diffuse or somewhat scanty.

**Common Names.** *Dendropanax arboreus*: potato wood (E), mano de león (S) *tz'ub* (M); *Oreopanax* sp.: mountain trumpet (E), *hubup* (M) (Balick et al. 2000).

**Sample Information.** Actun Chapat: 10079; Actun Halal: 10006, 20026, 20028, 20029.

### Arecaceae

**Description.** Most archaeobotanical remains identified as Arecaceae are composed of charred endocarp fragments. Arecaceae endocarps were recovered from Actun Nak Beh and Actun Halal. With the exception of those specimens identified as *Attalea cohune* (see below), the endocarps were not identified beyond the family due to their fragmentary nature. In addition to the endocarp remains, one fragment of Arecaceae charcoal was recovered from a disturbed context at Actun Chapat. Diagnostic attributes of the Arecaceae charcoal fragment are its “woody” appearance and its lack of secondary vascular tissue. Instead, vascular tissue is scattered in discrete bundles.

**Common Names.** Unknown genera and species. See below for common names of *Attalea cohune*.

**Sample Information.** Actun Nak Beh: 20001, 20011, 20012, 20014; Actun Halal: 20025, 20031; Actun Chapat: 20054.

#### *Attalea cohune*

**Description.** Archaeobotanical remains identified as *Attalea cohune* are composed of charred endocarp fragments. Endocarp surfaces have parallel striations running from the proximal to the distal ends. In large fragments, specimens have single and double interior cavities. In cross-section, vascular tissue appears as narrow, tubular protrusions of variable size, though most are approximately 100  $\mu\text{m}$  in diameter.

**Common Names.** Cohune (S), corozo (S), *tutz* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10011, 10025, 20004, 20006, 20008-20010.

### Bignoniaceae

**Description.** Two genera of Bignoniaceae charcoal were identified in the archaeobotanical assemblage. One, from Actun Chapat, was identified as *Tabebuia* sp. (see below). The other genus, from Tarantula Cave, is unknown, but it is distinct from the *Tabebuia* sp. charcoal specimens. This genus is diffuse porous in cross-section with small vessels between 40 and 50  $\mu\text{m}$  in diameter. Vessels are solitary and in radial chains of two to three. Vessel density is high, between 40 and 50 per  $\text{mm}^2$ . Rays are one to two cells wide. Axial parenchyma is paratracheal, ranging from unilaterally aliform to confluent, connecting two or three pores.

**Common Names.** Unknown genera and species. See below for common names of *Tabebuia* sp.

**Sample Information.** Tarantula Cave: 20021.

#### *Tabebuia* sp.

**Description.** *Tabebuia* sp. charcoal specimens are diffuse porous in cross-section with solitary vessels and vessels in radial chains of two to three. Vessels are between 80 and 100  $\mu\text{m}$  in diameter with approximately 12 to 15 per  $\text{mm}^2$ . Rays are one to three cells wide. Axial parenchyma is paratracheal; mostly narrow confluent bands but also aliform and vasicentric.

**Common Names.** Mayflower (E), cortes (S), *ix-makulis* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Chapat: 10071.

### Boraginaceae

#### *Cordia* sp.

**Description.** *Cordia* sp. charcoal is the only genus of Boraginaceae identified in the archaeobotanical assemblage. *Cordia* sp. specimens are diffuse porous in cross-section with medium to large vessels, between 100 and 130  $\mu\text{m}$  in diameter. Vessels are solitary with low density, between five and seven per  $\text{mm}^2$ . Vessels have tyloses. Rays are multiseriate, between four and five cells wide. Axial parenchyma is paratracheal, narrow aliform with short wings to confluent.

**Common Names.** Salmwood (E), *b'ojom* (M), *k'op te'* (M), (Atran and Ucan Ek' 1999; Balick et al. 2000; Marin et al. 1976).

**Sample Information.** Barton Creek Cave: 10046; Actun Chapat: 20056; Tarantula Cave: 20022.

### Burseraceae

**Description.** A number of charcoal specimens were identified as members of the family Burseraceae. Many were identified as the genus *Protium* (see below), but many were not identified to genus due to poor preservation of anatomical characteristics in cross-section.

Preservation particularly affected assessments of vessel density, preventing a sufficient determination of overall transverse appearance. Although it is possible that these specimens are a species of *Protium*, they may also be a species of the closely related genus *Bursera*, perhaps *B. simaruba*. Charcoal specimens identified as Burseraceae are diffuse porous in cross-section. Vessels are small, no more than 80 µm in diameter. Most vessels are solitary, but, in some better preserved specimens, they also appear to be in radial groups of no more than three. Vessel density is too distorted to determine. Rays are poorly preserved but most are biseriate. Axial parenchyma is not clearly visible.

**Common Names.** Unknown genera and species. See below for common names of *Protium* sp.

**Sample Information.** Barton Creek Cave: 10040, 10041, 10042, 10043, 10068, 20036, 20039; Actun Chapat: 20048.

#### *Protium* sp.

**Description.** *Protium* sp. was the only genus of Burseraceae charcoal identified in the archaeobotanical collection. Specimens identified solely as Burseraceae are similar to *Protium* sp. but may be a species of the closely related genus *Bursera*. *Protium* sp. charcoal specimens are diffuse porous in cross-section. Vessels are solitary or in radial chains of two or three, mostly two. Vessels are small, between 40 and 100 µm in diameter, and are relatively dense, between 60 and 70 per mm<sup>2</sup>. Rays are uniseriate and biseriate. Axial parenchyma is scanty paratracheal.

In addition to charcoal specimens identified as *Protium* sp., a single carbonized *Protium* sp. seed was recovered from Twin Caves 2. The seed is 11.7 mm long, 8.8 mm wide, and 4.3 mm thick. Overall, longitudinal shape is elliptic but the proximal point of articulation is acuminate to attenuate. On the ventral side, this point has a central, sharp ridge. The dorsal side has two shallow grooves running the length of the seed. In profile, the seed is mostly D-shaped, but slightly reniform.

**Common Names.** Copal (S), *pom* (M) (Arnason et al. 1980; Atran and Ucan Ek' 1999; Balick et al. 2000; Breedlove and Laughlin 1993; Flores and Balam 1997; Marin et al. 1976; Roys 1931; Stross 1997).

**Sample Information.** Barton Creek Cave: 10043, 10045, 10058, 10062, 10067b, 20038, 20047; Actun Chapat: 10070, 10071, 10077, 20049, 20057; Twin Caves 2: 20024.

#### Cecropiaceae

##### *Cecropia* sp.

**Description.** 293 uncarbonized *Cecropia* sp. seeds were recovered from Actun Chechem Ha. The seeds average

1.8 mm long, 1 mm wide, and 0.7 mm thick. The seeds are oblong to ovoid in shape with a basal hilum that is somewhat displaced to one side. The surface of the seeds is reticulate to somewhat bullate.

**Common Names.** Trumpet tree (E), guaramo (S), *k'och* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Chechem Ha: Field Season 1999: Ledge 7, Vessel Number 12015701; Field Season 2000: Elevated Passage 1, Vessel Number 11002201, 11002401, 11003001, 11001501; Ledge 7, Vessel Number 12015701, 1106101; Tunnel 2, Vessel Number 11050301.

#### Chrysobalanaceae

##### c.f. *Licania arborea*

**Description.** Identification of *Licania arborea* charcoal from one deposit at Actun Halal is based solely on comparisons of archaeobotanical specimens with descriptions and photomicrographs of *Licania* sp. wood anatomy contained in reference texts on Neotropical wood (Détienne and Jacquet 1983) and, thus, is tentative. Charcoal specimens are diffuse porous in cross-section with large vessels between 250 and 180 µm in diameter and approximately 10 vessels per mm<sup>2</sup>. Rays are uniseriate. Axial parenchyma consists of narrow apotracheal lines.

**Common Names.** Pigeon plum (E), *tzok'otz* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Halal: 10002.

#### Clusiaceae

##### *Rheedia* sp.

**Description.** *Rheedia* sp. charcoal is the only genus of Clusiaceae identified in the archaeobotanical assemblage. Specimens are diffuse porous in cross-section, between 15 and 20 per mm<sup>2</sup>. Vessels are between 90 and 100 µm in diameter. Rays are between two and four cells wide. Axial parenchyma is paratracheal, mostly unilaterally aliform but also confluent connecting two to three vessels.

**Common Names.** *ka-re-ché* (M) (Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10013.

#### Combretaceae

**Description.** A number of charcoal specimens were only identified to the family Combretaceae. Most specimens are similar to modern wood samples of *Terminalia amazonia* and *Bucida buceras*. In cross-section, charcoal specimens are mostly diffuse porous, though some appear to be slightly semi-ring porous due to lines of terminal parenchyma. Vessels are solitary and in radial chains of two to six with approximately 12 to 15 per mm<sup>2</sup>. Rays



are mostly two to three cells wide. Axial parenchyma is paratracheal, ranging from aliform to confluent.

**Common Names.** Unknown genera and species. See below for common names of *Terminalia* sp.

**Sample Information.** Actun Nak Beh: 10022a, 10030, 20004; Barton Creek Cave: 10051; Actun Halal: 20031.

#### *Terminalia* sp.

**Description.** *Terminalia* sp. was the only genus Combretaceae charcoal identified in the archaeobotanical assemblage from the caves. Charcoal specimens are anatomically similar to *Terminalia amazonia* wood. *Terminalia* sp. charcoal specimens are diffuse porous in cross-section. Vessels are solitary and in radial chains of two to five. Vessels are between 80 and 120 µm in diameter. Rays are mostly uniseriate. Axial parenchyma is paratracheal, either aliform or confluent connecting two to three vessels.

**Common Names.** Bully tree (E), nargusta (S), *k'an xa-an* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Barton Creek Cave: 20040.

#### Compositae

**Description.** Specimens identified as members of the Compositae (Asteraceae) family consist of three carbonized achenes, one from each Barton Creek Cave, Actun Halal, and Actun Nak Beh. There are over 85 Compositae genera in Belize today (Balick et al. 2000:148-154). Many of the specimens are probably intrusive (especially those from Actun Halal and Actun Nak Beh). Specimens from Actun Nak Beh and Actun Halal are morphologically similar, suggesting that they may be from the same genus. These achenes are flat, 1 mm long and 0.5 mm wide. Their surfaces are somewhat cancellate with longitudinal striations. The achene from Barton Creek Cave, however, is distinct. The specimen is structurally similar to fruits of species of *Ambrosia*. The achene is triangular in longitudinal shape, coming to a blunt point, with three facets in transverse shape. It is 2.7 mm long and 1.7 mm at its widest point. The achene's most distinctive attribute is the presence of short, spine-like projections or outgrowths on the fruit's side and top at each facet angle.

**Common Names.** Unknown genera and species.

**Sample Information.** Actun Nak Beh: 20008; Actun Halal: 20033; Barton Creek Cave: 20047.

#### Cucurbitaceae

##### *Cucurbita* sp.

**Description.** Specimens identified only as the genus *Cucurbita* are made up of charred rind fragments. Rind fragments can be used to distinguish between genera of

the Cucurbitaceae family (between *Cucurbita* and *Lagenaria*, for instance) but cannot be used to distinguish between different species of *Cucurbita* with confidence (Cutler and Whitaker 1961:475, 1967:213). *Cucurbita* sp. rinds were identified based primarily on internal anatomy in cross section because charring and the fragmented nature of the remains precluded using surface appearance to identify the remains. Rinds are between 3 and 4.5 mm in thickness. Large, isodiametric shaped cells with thin walls dominate the rind fragments in cross-section, though there are several layers of stone cells closer to the rind's surfaces.

**Common Names.** Unknown species. See below for common names of *C. pepo* and *C. moschata*.

**Sample Information.** Barton Creek Cave: 10067b, 20043; Actun Chapat: 20049.

##### *Cucurbita moschata*

**Description.** One seed identified as *Cucurbita moschata* was found at Barton Creek Cave. The seed is charred so seed color was not used to determine species. The seed is substantially shorter and rounder than specimens identified as *C. pepo* (see below). The seed is 11.53 mm wide and 6.63 mm long and is fringed by a narrow margin that is 0.4 mm wide. The margin of the seed is hairy (ciliolate), a characteristic of *C. moschata* seeds found in Veracruz and in southern Mexico and Guatemala (Cutler and Whitaker 1967:214).

**Common Names.** Squash (E), pepo squash (E), *k'uum* (M) (Atran and Ucan Ek' 1999; Cutler and Whitaker 1961).

**Sample Information.** Barton Creek Cave: 20043.

##### *Cucurbita pepo*

**Description.** Two complete *Cucurbita pepo* seeds and numerous *C. pepo* fragments were recovered from Barton Creek Cave. The seeds are charred so it was not possible to use seed color to identify the seeds. Seed surface texture is uniformly smooth. Seeds are long and narrow. One complete seed is 19.83 mm in length and 8.85 mm in width. The second complete seed is 18.20 mm long and 8.22 wide. Carbonization likely caused the seeds to swell in thickness. Seeds are fringed by a well-defined, narrow margin that is 0.5 to 0.6 mm wide.

**Common Names.** Squash (E), *tz'ool* (M) (Atran and Ucan Ek' 1999).

**Sample Information.** Barton Creek Cave: 20043-20044.

#### Euphorbiaceae

**Description.** Wood charcoal identified as belonging to the family Euphorbiaceae was recovered from Actun Chapat and Barton Creek Cave. Although the anatomy of

specimens from each cave varies, all share a number of attributes, and most are anatomically similar to *Gymnanthes lucida*. Euphorbiaceae charcoal is diffuse porous in cross-section with small vessels, between 20 and 50 µm in diameter, in radial chains of two to five. Rays appear to be mostly uniseriate. Axial parenchyma is distinctly apotracheal, forming a dense reticulate pattern.

**Common Names.** Unknown genera and species.

**Sample Information.** Barton Creek Cave: 10038, 10045, 10058; Actun Chapat: 10070, 10079, 20059.

## Fagaceae

### *Quercus* sp.

**Description.** *Quercus* sp. charcoal, from one deposit at Actun Chapat, is the only genus of Fagaceae identified in the archaeobotanical assemblages from the cave sites. *Quercus* sp. charcoal is diffuse porous in cross-section. Vessels are solitary and large, between 150 and 220 µm in diameter, with approximately 10 per mm<sup>2</sup>. Rays are both uniseriate and multiseriate; multiseriate rays are between 10 and 20 cells wide. Axial parenchyma is diffuse.

**Common Names.** Oak (E), encino (S) (Balick et al. 2000).

**Sample Information.** Actun Chapat: 10070.

## Flacourtiaceae

### *Casearia* sp.

**Description.** *Casearia* sp. charcoal was the only genus from Flacourtiaceae identified in the archaeobotanical assemblage. Charcoal specimens are diffuse porous in cross-section with small vessels between 15 and 25 µm in diameter. Vessels are mostly in radial chains of four to eight. Vessel density is high, between 40 and 70 per mm<sup>2</sup>. Rays are two to three cells wide. Axial parenchyma is not distinct.

**Common Names.** Billy hop (E), café de montaña (S), *iximche'* (M) (Balick et al. 2000).

**Sample Information.** Barton Creek Cave: 10046.

## Lauraceae

**Description.** Charcoal specimens identified only as Lauraceae are diffuse porous in cross-section. Vessels are mostly in radial chains of two to three. Most specimens have between 15 and 30 vessels per mm<sup>2</sup>. Rays are usually not more than three cells wide. Axial parenchyma is paratracheal, either vasicentric to scanty.

**Common Names.** Unknown genera and species. See below for common names of *Licaria* sp. and *Persea* sp.

**Sample Information.** Actun Nak Beh: 20002, 20003; Tarantula Cave: 20020; Actun Halal: 10004; Actun Chapat: 10072b; Barton Creek Cave: 10051, 20039, 20046.

### *Licaria* sp.

**Description.** *Licaria* sp. charcoal is diffuse porous in cross-section. Vessels are between 60 and 100 µm in diameter with approximately 35 per mm<sup>2</sup>. Vessels are solitary and in radial chains of two to four. Rays are between two and three cells wide. Axial parenchyma is vasicentric.

**Common Names.** Bastard oak (E), *ixtzo'otzi* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Chapat: 10079.

### *Persea* sp.

**Description.** Charcoal specimens identified as *Persea* sp. are diffuse porous in cross-section. Vessels are between 90 and 120 µm in diameter. Vessels are solitary and in radial chains of two to three with approximately 25 per mm<sup>2</sup>. Rays are uniseriate and multiseriate; multiseriate rays are between three and five cells wide. Axial parenchyma is scanty paratracheal to vasicentric.

**Common Names.** Avocado (E), agaucate (S), *on* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10021; Barton Creek Cave: 10041, 10046.

## Leguminosae

**Description.** A portion of the charcoal assemblage from Actun Nak Beh, Actun, Chapat, and Barton Creek Cave was only identified to the family Leguminosae. In general, there is substantial anatomical variation between most of these specimens. Nevertheless, all specimens share attributes common in Leguminosae wood. All specimens appear to be diffuse porous with medium to large vessels. Rays are mostly multiseriate, between two and five cells wide, but may also be uniseriate. The most diagnostic attribute of the Leguminosae is distinct paratracheal axial parenchyma. Axial parenchyma ranges from vasicentric several cells wide, aliform with short, broad wings, to confluent with wide bands.

**Common Names.** Unknown genera and species.

**Sample Information.** Actun Nak Beh: 10014; Barton Creek Cave: 10041, 10043; Actun Halal: 10004, 10006, 20034; Actun Chapat: 10069, 10070, 10072, 10079, 20051, 20057.

### *Albizia* sp.

**Description.** Charcoal identified as *Albizia* sp. is diffuse porous with vessels solitary and in radial chains of two to four. Vessels are large, between 150 and 180 µm in diameter. Vessel density is low to moderate, between eight and twelve per mm<sup>2</sup>. Rays are mostly biseriate. Axial parenchyma is paratracheal, either aliform with short, broad wings or confluent.

**Common Names.** Prickly yellow (E), wild tamarind (E), *xiahtsimin* (M) (Balick et al. 2000).

**Sample Information.** Actun Chapat: 20048.

#### *Andira inermis*

**Description.** *Andira inermis* charcoal specimens are diffuse porous in cross-section. Vessels are large, between 110 and 220 µm in diameter, and solitary as well as in radial chains of two to six. Vessel density is low, between five and ten per mm<sup>2</sup>. Rays are multiseriate, between three and four cells wide. Axial parenchyma is paratracheal, composed of wide confluent bands.

**Common Names.** Bastard cabbage bark (E), palo sangre (S), almendro (S), *iximche* (M) (Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10011, 10023.

#### *Cassia* sp.

**Description.** *Cassia* sp. charcoal specimens are diffuse porous in cross-section with large vessels between 90 and 120 µm in diameter. Vessels are solitary and in radial chains of two to three with low density, between six and seven per mm<sup>2</sup>. Rays are mostly uniseriate. Axial parenchyma is distinctly paratracheal, either widely vasicentric or aliform with short wings.

**Common Names.** Stinking toe (E), *b'ukut* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10021, 10022, 10024; Actun Chapat: 10079.

#### *Enterolobium* sp.

**Description.** Charcoal specimens identified as *Enterolobium* sp. are similar to modern comparative samples of *E. cyclocarpum*. Because *E. cyclocarpum* is the only species of *Enterolobium* in Belize today (Balick et al. 2000:83), it is likely that the charcoal specimens are members of this species. Specimens are diffuse porous with large vessels between 100 and 150 µm in diameter. Vessels are solitary and in radial chains of two to three, rarely four. Vessel density is low, between six to seven per mm<sup>2</sup>. Rays are narrow, between one and three cells wide. Axial parenchyma is paratracheal, including vasicentric several cells wide, aliform with broad, short wings, and confluent, connecting two to three vessels.

**Common Names.** Guanacaste (S), *pich* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Tarantula Cave: 20022.

#### c.f. *Hymenaea coubaril*

**Description.** Identification of charcoal specimens as *Hymenaea coubaril* is tentative due to a lack of comparative wood material during analysis. Identifications were made solely by comparing the anatomy of charcoal specimens to descriptions and micrographs in reference texts (Detienne and Paulette 1983; Kribs 1950) and to scanning electron micrographs of archaeological wood published elsewhere (Lentz et al. 1996a). In cross-section, vessels are evenly distributed but appear ring porous due to lines of terminal parenchyma. Vessels are between 60 and 150 µm in diameter and are solitary and in radial chains of two to three. Rays are multiseriate, between three and five cells wide. Axial parenchyma is paratracheal, either aliform with broad, short wings or confluent connecting two to four vessels.

**Common Names.** Broken ridge locust (E), guapinol (S), *punaayche'* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10020.

#### *Lonchocarpus* sp.

**Description.** *Lonchocarpus* sp. charcoal specimens are diffuse porous in cross-section with large vessels between 130 and 190 µm in diameter. Vessels are solitary and in radial chains of two to four. Vessel density is low with approximately six per mm<sup>2</sup>. Rays are between two and three cells wide. Axial parenchyma is paratracheal. Specimens identified as *Lonchocarpus* sp. have both aliform axial parenchyma with long wings and confluent axial parenchyma forming wide bands.

**Common Names.** Cabbage bark (E), *balche'* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000; Flores and Balam 1997; Marin et al. 1976; Roys 1931).

**Sample Information.** Barton Creek Cave: 10039, 10041, 20046; Actun Halal: 20034.

#### *Lysiloma* sp.

**Description.** *Lysiloma* sp. charcoal specimens are diffuse porous in cross-section. Vessels are between 70 and 180 µm in diameter and are solitary and in radial chains of two to four. Vessel density is low, between six and ten vessels per mm<sup>2</sup>. Rays are mostly uniseriate. Axial parenchyma is paratracheal, mostly aliform with long wings to confluent.

**Common Names.** Rain tree (E), *chalan* (E), *tzalam* (E) (Atran and Ucan Ek' 1999; Balick et al. 2000; Flores and Balam 1997; Marin et al. 1976; Roys 1931).

**Sample Information.** Barton Creek Cave: 10042, 20041.

***Phaseolus vulgaris***

**Description.** A single, carbonized *Phaseolus vulgaris* seed was recovered from Barton Creek Cave. The seed is 8.8 mm long and 4.9 mm wide. The seed is broadly kidney to plano-convex shaped with a centrally located hilum. Both cotyledons are intact. The seed coat is smooth, though carbonization obscures most seed coat attributes.

**Common Names.** Common bean (E), *b'u'ul* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Barton Creek Cave: 20046.

***Phaseolus* sp.**

**Description.** Seed fragments, one from Actun Chapat and one from Barton Creek Cave, were identified as *Phaseolus* sp. The incomplete nature of the seeds prevented species identification. The *Phaseolus* fragment from Barton Creek Cave consists of a single, carbonized cotyledon. The cotyledon is 6.46 mm long and 4.13 mm wide and kidney shaped. The center of the cotyledon is fragmented, exposing internal parenchyma tissue. The specimen from Actun Chapat is more complete with intact remnants of the smooth seed coat. The seed is 7.3 mm long and 4.4 mm wide. The hilum is not preserved on this specimen so species identification was not attempted.

**Common Names.** Unknown species. See above for common names of *Phaseolus vulgaris*.

**Sample Information.** Barton Creek Cave: 20043; Actun Chapat: 20055.

***Piscidia* sp.**

**Description.** Charcoal specimens identified as *Piscidia* sp. are similar to modern wood samples of *Piscidia piscipula*. *P. piscipula* is the only species of *Piscidia* listed by Balick et al. (2000:93) in their recent checklist of Belizean vascular plants. Thus, it is possible that the archaeobotanical specimens discussed here are *P. piscipula*. *Piscidia* sp. charcoal specimens are diffuse porous in cross-section with large vessels between 100 and 120  $\mu$ m in diameter. Vessels are mostly solitary but are also in radial chains of two to four with between eight and fourteen per  $\text{mm}^2$ . Rays are between one and four cells wide. Axial parenchyma is paratracheal with long, wavy confluent bands.

**Common Names.** Dogwood (E), *habín* (M) (Atran and Ucan Ek', Balick et al. 2000; Flores and Balam 1997; Marin et al. 1976; Roys 1931).

**Sample Information.** Barton Creek Cave: 10039, 10040, 10041, 10045, 10046, 20041, 20046; Actun Chapat: 20048, 20054, 20056, 20058.

***Schizolobium parahyba***

**Description.** Charcoal specimens identified as *Schizolobium parahyba* were recovered only from disturbed contexts at Actun Nak Beh. Thus, their archaeological significance is questionable. Specimens are diffuse porous in cross-section with large vessels between 120 and 220  $\mu$ m in diameter. Vessels are mostly solitary but are also in radial chains of two to three. Vessel density is low, between two and five per  $\text{mm}^2$ . Rays are narrow, most one cell wide. Axial parenchyma is vasicentric paratracheal.

**Common Names.** Quamwood (E), plumajillo (S) (Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10026, 20002.

**Malpighiaceae**

***Byrsonima* sp.**

**Description.** Charcoal specimens identified as *Byrsonima* sp. are diffuse porous in cross-section. Vessels are between 80 and 120  $\mu$ m in diameter. Vessels are solitary but mostly in radial groups of three to four with approximately 15 to 20 per  $\text{mm}^2$ . Rays are between three and four cells wide. Axial parenchyma is scanty paratracheal.

**Common Names.** Craboo, nance (S), *chi'* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Nak Beh: 10013, 10014, 10018, 10021, 10022, 20007; Actun Chapat: 10069, 10073, 10074, 10076, 10077, 10079, 20051, 20052, 20057, 20059; Barton Creek Cave: 10044, 10061, 10068, 20046, 20047.

***Byrsonima crassifolia***

**Description.** Carbonized *Byrsonima crassifolia* pits (pyrenes) and pit fragments were recovered from Actun Nak Beh and Twin Caves 2. The pits are subglobose in shape, between 6.0 and 8.1 mm long and between 5.1 and 6.7 mm wide, and somewhat flattened at the point of attachment. The pits' surfaces have raised striations and appear almost "wrinkled."

**Common Names.** See *Byrsonima* sp.

**Sample Information.** Actun Nak Beh: 10020, 10021; Twin Caves 2: 20024.

**Meliaceae**

**Description.** Charcoal from Actun Nak Beh and Actun Chapat was identified only to the family Meliaceae. Meliaceae charcoal from Actun Chapat was similar to the *Cedrela* sp. charcoal from the same site (see below), but

poor preservation limited determinations of ring porosity. Specimens from Actun Nak Beh, however, are more similar to species of *Guarea*. These specimens are diffuse porous with large vessels between 100 and 140 µm in diameter. Rays are indistinct. Axial parenchyma is paratracheal, consisting of long, narrow confluent bands.

**Common Names.** Unknown genera and species. See below for common names of *Cedrela* sp.

**Sample Information.** Actun Nak Beh: 10008, 10009, 10022a, 20001, 20004, 20007; Actun Chapat: 10073, 10074, 10078.

#### *Cedrela* sp.

**Description.** Although a number of charcoal specimens were identified as belonging to the family Meliaceae, *Cedrela* was the only clearly recognizable genus. In cross-section, specimens identified as *Cedrela* sp. are distinctly ring-porous with large early wood vessels between 150 and 190 µm in diameter. Late wood vessels are smaller, between 90 and 130 µm in diameter, and are more evenly distributed as either solitary pores or in radial chains of 2 to 4. Axial parenchyma is scanty paratracheal to slightly aliform. Rays are multi-seriate, between 3 to 4 cells wide.

**Common Names.** Spanish cedar (E), cedro (S), *k'uche* (M) (Balick et al. 2000; Marin et al. 1976).

**Sample Information.** Barton Creek Cave: 10043, 10046, 2004, 20047; Actun Chapat: 10069.

#### Moraceae

**Description.** Specimens of Moraceae charcoal not identified to genus are probably species of *Ficus* (see below). Identification did not proceed to the genus level due to poor preservation that distorted axial parenchyma bands and rays.

**Common Names.** Unknown genus and species. See below for common names of *Ficus* sp.

**Sample Information.** Barton Creek Cave: 10043, 10045; Actun Nak Beh: 10021.

#### *Ficus* sp.

**Description.** Of all specimens identified as belonging to the Moraceae family, *Ficus* was the only genus identified. Most specimens identified only as Moraceae charcoal were similar to *Ficus*, but were too poorly preserved for further identification. *Ficus* sp. specimens are diffuse-porous in cross-section with large vessels between 130 and 200 µm in diameter. Vessels are solitary and in radial pairs. Rays are multiseriate, between two and four cells wide. The presence of distinct, evenly distributed bands of axial parenchyma is the most diagnostic attribute of specimens identified as *Ficus* sp.. Because there are over

twenty species of *Ficus* in Belize today (Balick et al. 2000:57-58), charcoal specimens were not identified beyond genus.

**Common Names.** Fig (E), *sab'ak che'* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Barton Creek Cave: 10043, 10044, 10045, 10046, 10051, 10057; Actun Halal: 10004.

#### Passifloraceae

##### *Passiflora* sp.

**Description.** A single, carbonized seed identified as a species of *Passiflora* was recovered from Twin Caves 2. The seed is 6.2 mm long, 3.4 mm wide, and 1.7 mm thick. It is ovate to elliptic in shape, though slightly truncated at the proximal/funicular end. The funiculus is off to one side of the proximal end rather than being centrally positioned. The seed surface is reticulate to alveolate/cancellate with numerous impressed pits. The exact species of the *Passiflora* seed is unknown. There are over 20 known species of *Passiflora* in Belize today (Balick et al. 2000:73-74). Thus, it is difficult and misleading to specify the particular species of *Passiflora* recovered based on a single seed.

**Common Names.** Passion fruit (E), granadilla (S), bat wing (E), *sa-yép* (M), *shik'sooc* (M) (Arnason et al. 1980; Balick et al. 2000).

**Sample Information.** Twin Caves 2: 20023

#### Pinaceae

##### *Pinus* sp.

**Description.** *Pinus* sp. charcoal is the only taxa from the Pinaceae family identified in the archaeobotanical assemblage, which is not surprising because it is the only genus from this family that inhabits modern Belizean forests (Balick et al. 2000:49). *Pinus* sp. was the most common wood charcoal in the archaeobotanical assemblage (Chapter 5). *Pinus* sp. wood is distinct in cross-section. The wood lacks vessel elements characteristic of angiosperm anatomy and is composed of a uniform distribution of tracheids. The majority of the wood specimens also displayed conspicuous resin ducts, an attribute of gymnosperms. It was not possible to discern the species of the pine charcoal. Two species of pine exist in Belize, *Pinus caribaea* and *P. oocarpa* (Balick et al. 2000:49). *P. caribaea* is generally found at lower elevations but may inhabit areas as high as 900 meters above sea level. *P. oocarpa*, on the other hand, is found at higher elevations between 1000 and 2700 meters (Standley and Steyermark 1958: 46-51). Due to the Upper Belize Valley's proximity to the Mountain Pine Ridge, a region dominated by *P. oocarpa*, it is likely that the pine remains are *P. oocarpa*.

**Common Names.** Pine, pino, ocote, *taj\**, *jujub* (Atran and Ucan Ek' 1999; Balick et al. 2000; Breedlove and Laughlin 2000).

**Sample Information.** Actun Nak Beh: 10010, 10012-10024, 10027, 10029-10037, 2001-20018; Twin Caves 2: 20023-20024; Tarantula Cave: 20019-20022; Barton Creek Cave: 10039, 10042-10046, 10051, 10055, 10056, 10058, 10059, 10064, 10065, 10067b, 10068, 20036, 20037, 20039-20044, 20046, 20047; Actun Halal: 10002-10006, 20025-20028, 20030-20032, 30034; Actun Chapat: 10069, 10071, 10072, 10073-10075, 20048-20052, 20054-20059; Actun Chechem Ha: 1998 Season: Ledge 4, Stone Circles 8-9; Crawl 3, Hearth Contents; 1999 Season: Ledge 7, Vessel Number 12015701; Ledge 10, Stack 7; Ledge 11, Stone Circle; Elevated Passage 3; Chamber 3, Vessel Number 12026001; 2000 Season: Elevated Passage 1, Vessel Numbers 11002201, 11002301, 11002401, 11003001, 11001501, 11003401; Ledge 7, Vessel Numbers 11016101, 11017301; Crawl 3, Vessel Number 11045901; Crawl 3, Hearth Contents; Tunnel 2, Vessel Numbers 11050201, 11048901, 11050301.

## Piperaceae

### *Piper* sp.

**Description.** Seeds are uncarbonized and 0.8 x 0.8 x 0.3 mm in size. Seeds are rectangular and broadly obovoid in shape with dorsiventral flattening. Seed color is brown to black, and the surface is reticulate.

**Common Names.** Spanish elder (E), bull hoof (E), cow's foot (E), cordoncillo (S), *xmakulan* (M) (Atran and Ucan Ek' 1999; Flores and Balam 1997; Balick et al. 2000).

**Sample Information.** Actun Chechem Ha: 1999 Season: Ledge 7, Vessel Number 12015701; Ledge 11, Stone Circle; Chamber 2, Vessel Number 12026001; 2000 Season: Elevated Passage 1, Vessel Numbers 11002201, 11002301, 11001501, 11003401; Ledge 7, Vessel Number 12015701; Crawl 3, Vessel Number 11045901; Crawl 3, Hearth Contents.

## Poaceae

### *Zea mays*

**Description.** *Zea mays* remains are abundant at the cave sites and are composed of cob fragments, including complete and fragmentary cupules and glumes, complete cobs, complete and fragmented kernels, and complete ears with the leaf sheaths (husks) intact. See Chapter 5 for an in depth discussion of the morphological attributes of the *Zea mays* remains.

**Common Names.** Maize (E), corn (E) maiz (S), *nal* (M), *ixim* (M) (Atran and Ucan Ek' 1999; Flores and Balam 1997).

**Sample Information.** Barton Creek Cave: 10055, 10062-10066, 10067b, 10068, 20036-20040, 20042-20044, 20046, 20047; Actun Chapat: 10069, 10071, 10073-10075, 20048-20052, 20054-20059; Actun Chechem Ha: 1998 Season: Ledge 6, Olla 3; Elevated Passage 3; Crawl 3, Hearth Contents; 2000 Season: Crawl 3, Hearth Contents.

## Rubiaceae

**Description.** A number of charcoal specimens were identified as belonging to the family Rubiaceae. No Rubiaceae specimens were identified to genus mainly due to a lack of comparative material. Nevertheless, specimens were identified based on similarities common to a number of Rubiaceae genera, such as *Calycophyllum*, *Genipe*, and *Hamelia*. Specimens are diffuse-porous in cross-section with small vessels, between 20 and 40 µm in diameter. Vessels are solitary and in radial chains of two to four. Axial parenchyma is scanty paratracheal. Rays are multi-seriate, between two and four cells wide.

**Common Names.** Unknown genera and species.

**Sample Information.** Barton Creek Cave: 10062; Actun Chapat: 10076, 10077, 10079, 20052, 20058; Actun Halal: 10006.

## Rutaceae

### *Zanthoxylum* sp.

**Description.** *Zanthoxylum* sp. charcoal is the only representative of Rutaceae identified in the archaeobotanical assemblage. Specimens are diffuse porous in cross section with small vessels between 30 and 80 µm in diameter. Vessels are mostly solitary but are also in radial chains of two to three. Rays are between one and three cells wide. Axial parenchyma is scanty to diffuse paratracheal.

**Common Names.** Prickly yellow (E), *sinanche*' (M) (Ankli et al. 1999; Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Barton Creek Cave: 10042, 10059, 10060, 10064, 20042-20044; Actun Chapat: 10076, 10079, 20057.

## Sapindaceae

### *Allophylus* sp.

**Description.** Charcoal specimens identified as *Allophylus* sp. are diffuse porous in cross-section with solitary vessels and vessels in radial chains of two to three, mostly two. Vessels are between 60 and 100 µm in diameter with approximately 16 per mm<sup>2</sup>. Rays are uniseriate. Axial parenchyma is paratracheal, mostly with confluent bands.

**Common Names.** Cherry (E), huesillo (S), *ixb'aach* (M), *bichach* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Chapat: 10072-10073; Barton Creek Cave: 10040.

#### *Matayba* sp.

**Description.** *Matayba* sp. charcoal is diffuse porous in cross-section. Vessels are mostly solitary but are also in radial chains of two or three. Vessels are between 40 and 80 µm in diameter with approximately 15 per mm<sup>2</sup>. Rays are uniseriate. Axial parenchyma is apotracheal.

**Common Names.** Carbon (S), wayum (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Chapat: 10079.

#### Sapotaceae

**Description.** A number of charcoal specimens from the cave sites were identified only to the family Sapotaceae. Poor vessel preservation was the primary limitation in genus identification. The nature of porosity was discernible, however, and all specimens appear to be diffuse porous. Vessel size and density is obscured by preservation, but specimens have both solitary vessels and radially aligned vessels. Rays are between one and three cells wide. Axial parenchyma is diagnostic. Axial parenchyma is apotracheal with long, narrow lines that are between one and three cells wide. The distribution of the axial parenchyma in relation to the radial parenchyma creates a slightly reticulate/lattice pattern in cross-section.

**Common Names.** Unknown genera and species. See below for common names of *Pouteria* sp.

**Sample Information.** Tarantula Cave: 20019, 20021; Actun Halal: 20027; Actun Chapat: 10078, 20059; Barton Creek Cave: 10044, 10046, 10060, 20036, 20039, 20040.

#### *Pouteria* sp.

*Pouteria* sp. was the only identifiable genus of charcoal out of all the Sapotaceae charcoal specimens. Specimens are diffuse porous in cross-section, between 10 and 12 per mm<sup>2</sup>. Vessels are between 80 and 120 µm in diameter and are solitary and in radial chains of two to four. Rays are uniseriate. Axial parenchyma is distinctly apotracheal in narrow lines about one to three cells wide, forming a slight reticulate pattern.

**Common Names.** Mamey apple (E), sapote (S), *haz* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000).

**Sample Information.** Actun Halal: 20030; Barton Creek Cave: 10051.

#### Simaroubaceae

#### c.f. *Alvaradoa amorphoides*

**Description.** Charcoal from one deposit at Actun Nak Beh was tentatively identified as *Alvaradoa amorphoides*. Specimens were poorly preserved due to a build up of calcium carbonate that obscured some features in cross-section. *Alvaradoa amorphoides* charcoal is diffuse porous in cross-section with small vessels, between 30 and 60 µm in diameter, distributed in radial to slightly oblique chains of two to five. Vessel density is relatively high, between 40 and 50 per mm<sup>2</sup>. Rays are difficult to discern, but appear to be no more than one or two cells wide. Axial parenchyma consists of narrow paratracheal bands.

**Common Names.** Cortacuero (S), *b'eel sinikche'* (M), *tzutzula* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000; Comerfield 1996).

**Sample Information.** Actun Nak Beh: 10020.

#### Solanaceae

##### *Capsicum annuum*

Forty-one charred seeds identified as *Capsicum annuum* were recovered from Barton Creek Cave. The seeds average 2.81 x 2.33 mm and are reniform in shape..

**Common Names.** Chile pepper (E), *ik* (M), *xmaax iik* (M) (Atran and Ucan Ek' 1999; Balick et al. 2000; Flores and Balam 1997).

**Sample Information.** Barton Creek Cave: 20043.

##### *Solanum* sp.

**Description.** The seeds are uncarbonized, dark orange to reddish in color with an undulate-reticulate surface texture. Seed shape is broadly elliptic to somewhat reniform, averaging 3.8 x 3.1 mm in size.

**Common Names.** Nightshade (E), hoja de puojillo (S), *chayuk'* (M), *chuuch* (M), *uk'uch* (M) (Arnason et al. 1980; Atran and Ucan Ek'; Balick et al. 2000)

**Sample Information.** Actun Chechem Ha: 1998 Season: Tunnel 2, Vessel Number 11048901; 1999 Season: Ledge 7, Vessel Number 12015701; Ledge 11, Stone Circle; 2000 Season: Elevated Passage 1, Vessel Numbers: 11002201, 11002301, 11002401, 11003001, 11001501, 11003401; Ledge 7 Vessel Numbers 12015701, 11015101; Crawl 3, Vessel Number 11045901; Crawl 3, Hearth Contents; Tunnel 2, Vessel Number 11050301.

#### Sterculiaceae

##### *Theobroma* sp.

**Description.** Charcoal identified as *Theobroma* sp. was recovered only from Barton Creek Cave. The *Theobroma* sp. charcoal is from a young stem or a branch; specimens have small diameters and the central pith is intact. Specimens are diffuse-porous in cross-section with small vessels, between 40 and 70 µm in diameter. Vessels are solitary or in pairs of two. Rays are multiseriate, between two and seven cells wide.

**Common Names.** Cacao.

**Sample Information.** Barton Creek Cave: 10067b, 10068.

#### **Vitaceae**

##### ***Vitis tiliifolia***

**Description.** Two *Vitis tiliifolia* seeds are the only archaeobotanical specimens from the Vitaceae family. Both seeds are charred. They are small, between 3.6 and 3.8 mm wide and 4.6 and 4.8 mm long, and distinctly pyriform in longitudinal shape and sulcate in transverse shape.

**Common Names.** Wild Grape (E), water tie-tie (E), behuco de uva (E), *ha-ix-ak* (M), *xta'ka'anil* (M) (Balick et al. 2000; Flores and Balam 1997).

**Sample Information.** Barton Creek Cave: 10058, 20043.



## APPENDIX C

### COMPARATIVE MAIZE DATA

Cup= cupule, Len= length, Wid= width, Dia= diameter. All measurements in mm.

1= Wellhausen et al. 1952, 2= Benx 1986, 3= Author, 4= Rust and Leyden 1994, 5= Lentz 1991, 6= Lentz et al. 1996a, 7= Miksicek et al. 1981.

| Maize Type                       | Row # | Ear/Cob Len | Ear Dia | Cob Dia | Rachis Dia | Kernel Len | Kern Wid | Kern Thick | Cup Wid | Cup Len | Cup Wing Wid | Glume Wid |
|----------------------------------|-------|-------------|---------|---------|------------|------------|----------|------------|---------|---------|--------------|-----------|
| Arrocillo Amarillo <sup>1</sup>  | 15.4  | 98          | 27      | 15.6    | 8.4        | 8.8        | 5.5      | 2.5        | n.a.    | n.a.    | n.a.         | n.a.      |
| Cacahuacintle <sup>1</sup>       | 15.2  | 145         | 47      | 27.2    | 11.7       | 14         | 9.8      | 5.2        | n.a.    | n.a.    | n.a.         | n.a.      |
| Chapalote <sup>1</sup>           | 12.3  | 110         | 29      | 22      | 11.2       | 7.2        | 6.7      | 4.1        | n.a.    | n.a.    | n.a.         | n.a.      |
| Harinoso de Ocho <sup>1</sup>    | 8     | 191         | 38      | 21.7    | 10.7       | 11.2       | 12       | 4.4        | n.a.    | n.a.    | n.a.         | n.a.      |
| Nal Tel <sup>1</sup>             | 11.4  | 79          | 27      | 19.2    | 9.2        | 7.4        | 6.7      | 3.9        | n.a.    | n.a.    | n.a.         | n.a.      |
| Olotillo <sup>1</sup>            | 9.4   | 198         | 38      | 22.7    | 9.7        | 11.7       | 10.8     | 3.9        | n.a.    | n.a.    | n.a.         | n.a.      |
| Palomero Toluqueno <sup>1</sup>  | 23    | 102         | 34      | 19.5    | 10.4       | 11.4       | 4.7      | 2.8        | n.a.    | n.a.    | n.a.         | n.a.      |
| Tepecintle <sup>1</sup>          | 11.8  | 104         | 49      | 32.8    | 20.5       | 11.9       | 9.1      | 3.7        | n.a.    | n.a.    | n.a.         | n.a.      |
| Zapalote Chico <sup>1</sup>      | 10.7  | 99          | 42      | 23.3    | 14         | 10.1       | 9.8      | 3.6        | n.a.    | n.a.    | n.a.         | n.a.      |
| Zapalote Grande <sup>1</sup>     | 15.7  | 148         | 49      | 31.5    | 19.2       | 11.1       | 9.3      | 3.8        | n.a.    | n.a.    | n.a.         | n.a.      |
| Chapalote <sup>2</sup>           | 10    | 122         | 25.5    | 17.5    | 8          | 6.7        | 6.75     | 3.75       | 5.55    | n.a.    | 1.45         | n.a.      |
| Dzit Bacal <sup>2</sup>          | 10    | 162         | 39.5    | 20.5    | 11         | 11.15      | 9.65     | 3.05       | 7.4     | n.a.    | 1.85         | n.a.      |
| Conejo <sup>2</sup>              | 10.4  | 153         | 37.5    | 21.5    | 11.5       | 9.55       | 9.55     | 3.9        | 8.1     | n.a.    | 1.95         | n.a.      |
| Chatzino Maizon <sup>2</sup>     | 11    | 120         | 38.5    | 20      | 11         | 8.85       | 8.6      | 3.6        | 7.55    | n.a.    | 1.75         | n.a.      |
| Zapalote <sup>2</sup>            | 10.8  | 114         | 40.5    | 22      | 12.5       | 10.4       | 9.5      | 4.05       | 8.45    | n.a.    | 1.85         | n.a.      |
| Bolita <sup>2</sup>              | 10.3  | 127         | 42.5    | 22.5    | 11.5       | 11.7       | 9.75     | 3.7        | 7.7     | n.a.    | 1.95         | n.a.      |
| Nal Tel <sup>2</sup>             | 11.35 | 115         | 34.5    | 19      | 9.5        | 8.9        | 8        | 3.45       | 5.85    | n.a.    | 1.3          | n.a.      |
| Arrocillo <sup>2</sup>           | 16.85 | 95          | 37      | 16.5    | 8          | 11         | 5.8      | 3.4        | 3.9     | n.a.    | 0.9          | n.a.      |
| Nal Tel <sup>3</sup>             | 12    | 86.7        | 32.2    | 21.8    | 10.2       | 8.58       | 7.7      | 4.13       | 7.1     | 2.8     | 1.1          | 4.1       |
| Early/Late La Venta <sup>4</sup> | n.a.  | n.a.        | n.a.    | n.a.    | n.a.       | 4.75       | 4.25     | n.a.       | 2.5     | n.a.    | n.a.         | n.a.      |
| Copan 1/23/174 <sup>5</sup>      | 12.6  | n.a.        | n.a.    | n.a.    | n.a.       | n.a.       | n.a.     | 4.2        | n.a.    | n.a.    | n.a.         | n.a.      |
| Copan 1/28/20 <sup>5</sup>       | 13    | n.a.        | n.a.    | n.a.    | n.a.       | n.a.       | n.a.     | 4.6        | n.a.    | n.a.    | n.a.         | n.a.      |
| Copan 4/111/20 <sup>5</sup>      | 12    | n.a.        | n.a.    | n.a.    | n.a.       | n.a.       | n.a.     | 5.1        | n.a.    | n.a.    | n.a.         | n.a.      |
| Ceren <sup>6</sup>               | 13.1  | n.a.        | n.a.    | n.a.    | n.a.       | n.a.       | 6.3      | 4.3        | n.a.    | n.a.    | n.a.         | n.a.      |
| Swasey Type 1 <sup>7</sup>       | 12.8  | n.a.        | n.a.    | n.a.    | 5.2        | n.a.       | 4.2      | 3.2        | 2.4     | 1.6     | 0.8          | n.a.      |
| Swasey Type 2 <sup>7</sup>       | 12.9  | n.a.        | n.a.    | n.a.    | 6.2        | n.a.       | 5.6      | 4.2        | 2.9     | 1.7     | 0.9          | n.a.      |
| Swasey Type 3 <sup>7</sup>       | 11.5  | n.a.        | n.a.    | n.a.    | 7.2        | n.a.       | 6.2      | 4.8        | 3.6     | 2.1     | 1.2          | n.a.      |
| Mamom Type 1 <sup>7</sup>        | 11.4  | n.a.        | n.a.    | n.a.    | 8.6        | n.a.       | 6.4      | 4.6        | 4.6     | 2.2     | 1.3          | n.a.      |
| Mamom Type 2 <sup>7</sup>        | 10    | n.a.        | n.a.    | n.a.    | 10.1       | n.a.       | 6.8      | 4.3        | 5.9     | 2.5     | 1.9          | n.a.      |
| Chicanel Type 1 <sup>7</sup>     | 12.3  | n.a.        | n.a.    | n.a.    | 9.3        | n.a.       | 6.5      | 5          | 4.6     | 3       | 1.8          | n.a.      |

## Appendix D

### Results of Radiometric Analysis (Beta Analytic, Miami, Florida)

| Sample Data<br>Conventional<br>Age(*)                                                                                                                                                                                                                                                | Measured<br>Radiocarbon Age | 13C/12C<br>Ratio | Radiocarbon |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------|-------------|
| <hr/>                                                                                                                                                                                                                                                                                |                             |                  |             |
| Beta – 164695 (Chapat, CH 3B, Unit 12, Level 3)<br>25.0* o/oo<br>SAMPLE : 10001<br>ANALYSIS : Radiometric-Standard delivery (with extended counting)<br>MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid<br>2 SIGMA CALIBRATION : Cal AD 660 to 970 (Cal BP 1290 to 980) | 1240 +/- 70* BP             | 1240 +/- 70 BP   | -           |
| <hr/>                                                                                                                                                                                                                                                                                |                             |                  |             |
| Beta – 164696 (Chapat, CH 3B, Unit 10, Level 3)<br>25.0* o/oo<br>SAMPLE : 10002<br>ANALYSIS : Radiometric-Standard delivery<br>MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid<br>2 SIGMA CALIBRATION : Cal AD 410 to 650 (Cal BP 1540 to 1300)                         | 1530 +/- 60* BP             | 1530 +/- 60 BP   | -           |
| <hr/>                                                                                                                                                                                                                                                                                |                             |                  |             |

## CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **Beta-164695**

Conventional radiocarbon age<sup>1</sup>: **1240±70 BP**

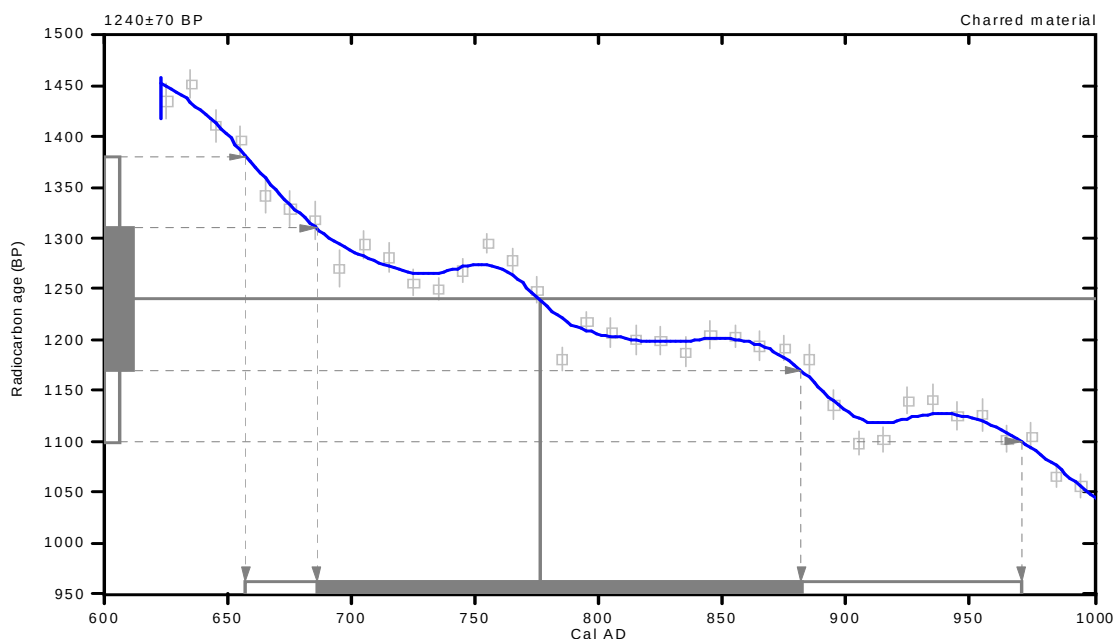
**2 Sigma calibrated result: Cal AD 660 to 970 (Cal BP 1290 to 980)**  
(95% probability)

<sup>1</sup> C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 780 (Cal BP 1170)

**1 Sigma calibrated result: Cal AD 690 to 880 (Cal BP 1260 to 1070)**  
(68% probability)



### References:

#### Database used

#### Calibration Database

#### Editorial Comment

Stuiver, M., van der Plicht, H., 1998, *Radiocarbon* 40(3), pxi-xiii

#### INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, *Radiocarbon* 40(3), p1041-1083

#### Mathematics

#### A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2), p317-322

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## CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: est. C13/C12=-25;lab. mult=1)

Laboratory number: **Beta-164696**

Conventional radiocarbon age<sup>1</sup>: **1530±60 BP**

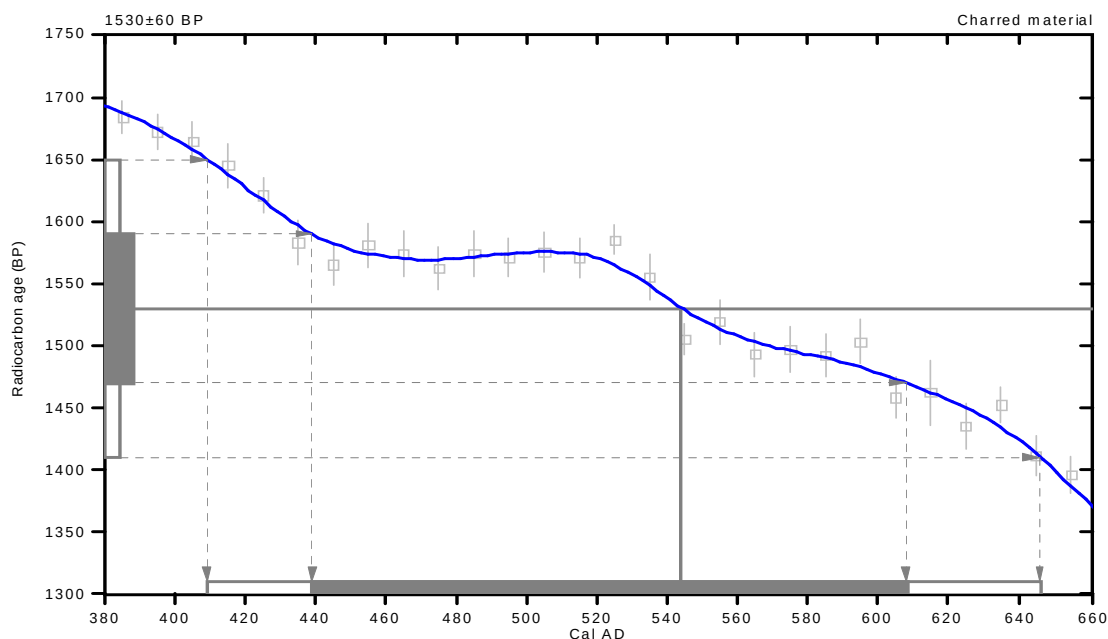
**2 Sigma calibrated result: Cal AD 410 to 650 (Cal BP 1540 to 1300)**  
(95% probability)

<sup>1</sup> C13/C12 ratio estimated

Intercept data

Intercept of radiocarbon age  
with calibration curve: Cal AD 540 (Cal BP 1410)

**1 Sigma calibrated result: Cal AD 440 to 610 (Cal BP 1510 to 1340)**  
(68% probability)



### References:

#### Database used

#### Calibration Database

#### Editorial Comment

Stuiver, M., van der Plicht, H., 1998, *Radiocarbon* 40(3), pxi-xiii

#### INTCAL98 Radiocarbon Age Calibration

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## APPENDIX E

### GLOSSARY OF TERMS USED

(Terms adapted from Emory [1980], Harris and Harris [1994], Mauseth [1988], and Pearsall [2000])

**Achene** A small, indehiscent fruit with a single seed.

**Acuminate** Gradual tapering into a point.

**Aliform axial parenchyma** A type of paratracheal axial parenchyma in which the parenchyma usually forms a sheath around the cells but always forms tangential wings.

**Alveolate** Honeycombed surface texture.

**Amyloplast** A plastid that stores starch.

**Apotracheal axial parenchyma** Parenchyma cells in the axial system of dicot wood that are scattered and not immediately associated with vessels.

**Attenuate** Gradual tapering to a narrow tip or base.

**Axial parenchyma** Non-lignified cells in the secondary body of stems that exhibit distinct patterns.

**Bulk samples** One set amount of soil collected from one locus in an archaeological context or deposit.

**Bullate** Surface covered with rounded projections.

**Calyx** The collective term for all the sepals of a flower. In some plants, the calyx remains as a base after the development of the fruit.

**Cancellate** Surface with a fine, regular lattice pattern.

**Caryopsis** A dry, one-seeded, indehiscent fruit in which the seed coat has fused with the pericarp.

**Charcoal** The carbonized remains of a plant's woody structures.

**Ciliolate** Having a hairy margin.

**Cotyledon** The primary leaf of the embryo, also called a seed leaf.

**Composite samples** Small amounts of soil are collected throughout one archaeological deposit or context and added together until a set volume of soil is achieved. This technique often increases the representation of archaeobotanical remains from an archaeological context. Also called "pinch" or "grab" samples.

**Confluent axial parenchyma** A type of paratracheal axial parenchyma that forms into long, often wavy, bands.

**Convex** Curved and rounded outward.

**Cupule** A pit or cup-shaped structure on the maize cob. It is the most durable part of the cob. Also called the alveolus.

**Dicot** Dicotyledons. Plant that develops with a pair of cotyledons. Most dicots undergo secondary growth.

**Diffuse axial parenchyma** A type of apotracheal axial parenchyma in which the parenchyma occurs as isolated strands not associated with vessels.

**Diffuse porous** In cross section, the distribution of vessels is uniform or even; opposite of ring porous.

**Direction of twist** In textiles, refers to the direction of twist in spun or plied yarns. The direction of twist is either S or Z depending on the trend of the yarn's spiral. Z-twist is when the spiral conforms to the central slant of the letter "Z", and S-twist is when the spiral conforms to the central slant of the letter "S".

**Disseminule** A general term to describe the structure responsible for dispersal, such as a seed or fruit (e.g. achene).

**Distal** The tip of a structure, opposite the point of attachment.

**Dorsal** The back of a structure.

**Dorsiventral** Having flattened upper and lower surfaces.

**Drupe** A fleshy fruit with a stony endocarp or pyrene.

**Elliptic** Narrow oval shape.

**Endocarp** The inner layer of a fruit wall. In this study, endocarp refers to fragmented pits or nutshells.

**Float** In textiles, any portion of a warp or weft element that extends over two or more units of the opposite set of elements on either face of a fabric.

**Floral Bud** An undeveloped flower.

**Fruit** A ripened ovary, including all its constituent structures (e.g., endocarp and seeds).

**Funiculus** The stalk of the seed that connects the ovule to the placenta.

**Globose** Spherical.

**Glume** A bract, or modified leaf-like structure, that surrounds the maize kernel on a cob. There are lower and upper glumes.

**Hardwood** In this study, hardwood refers to the wood of angiosperms. Hardwoods are identified by the presence of vessels, or pores, in the wood.

**Hilum** A scar on a seed that displays its point of attachment.

**Indehiscent** Not opening at maturity.

**Macrofloral remains** Archaeobotanical remains that can be seen with the unaided eye.

**Microfloral remains** Archaeobotanical remains that cannot be seen with the unaided eye.

**Monocot** Monocotyledon. Plant that develops with one cotyledon. Most monocots do not undergo secondary growth.

**Ovoid** Egg-shaped.

**Palynology** The study of pollen.

**Paratracheal axial parenchyma** Parenchyma cells in the axial system of dicot wood that are immediately adjacent to the vessels.

**Parenchyma** A cell/tissue type composed of cells that only have primary walls.

**Pericarp** The outer wall of a fruit.

**Pit** Stony endocarp of a fruit (drupe).

**Plano-convex** Shape that is flat on one side and convex on the opposite side.

**Plastid** A class of structures that are involved in metabolism.

**Plying** The process of twisting together two or more spun yarns. Also called doubling.

**Proximal** The base of a structure, or at the point of attachment.

**Pyrene** The stone or pit of a drupe.

**Pyriform** Pear-shaped.

**Rays** Radially distributed parenchyma cells in the secondary body of stems.

**Reniform** Kidney-shaped.

**Rind** A thick, outer covering of a fruit

**Ring porous** In cross-section, the distribution of vessels appears as a ring due to the larger diameter of vessels in early wood compared to late wood.

**Secondary growth** Horizontal growth, or wood development.

**Seed** A ripe ovary.

**Seed Coat** The outer covering of a seed, also called a testa.

**Sepal** A segment of the calyx.

**Scanty axial parenchyma** A type of paratracheal axial parenchyma in which the parenchyma does not form a complete sheath around vessels.

**Shoot** Stem. Primary body of a plant.

**Shank** Short shoot of maize plant that connects to the base of the ear.

**Spinning** Twisting together massed short fibers into a continuous strand. The direction of twist can be either Z or S.

**Subglobose** Slightly spherical.

**Sulcate** Surface with longitudinal grooves or furrows.

**Terminal axial parenchyma** A type of apotracheal axial parenchyma that is concentrated at the outer boundary of an annual ring.

**Transverse** A view of an object in cross-section.

**Twill** Float weaves characterized by a diagonal alignment of floats.

**Tyloses** Parenchyma cells that have entered and formed a seal in a vessel.

**Ubiquity** The presence or absence of a taxon. This is commonly expressed as a percentage. Ubiquity often examines the number of samples in which a particular taxon occurs. In this study, multiple samples were sometimes recovered from one spatially and temporally associated context. Thus, ubiquity is used here to refer to the number of contexts or deposits containing a particular taxon.

**Unilateral axial parenchyma** Paratracheal axial parenchyma that does not form a complete sheath around the vessels and is located on only one side.

**Vascular Tissue** Specialized cells that conduct water and minerals. Composed of xylem and phloem.

**Vasicentric axial parenchyma** Paratracheal axial parenchyma that forms a complete sheath around vessels.

**Ventral** The front of a structure.

**Vessels** multicellular, conducting structures in the xylem of angiosperms.

**Warp** Parallel elements that run longitudinally in textiles. They are crossed and interworked at right angles by the weft elements.

**Weft** Transverse elements in textiles that cross and interwork at right angles with the warp elements.

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